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THESIS

DOCUMENTATION AND EVALUATION OF DEPOT
MAINTENANCE COST ACCUMULATION AND REPORTING
AT THE SACRAMENTO ARMY DEPOT, SACRAMENTO,
CALIFORNIA

by

Kevin James Tackett

June 1984

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Documentation and Evaluation of Depot Maintenance
Cost Accumulation and Reporting at the Sacramento
Army Depot, Sacramento, California

by

Kevin James Tackett
Lieutenant Commander, United States Navy
B.S., University of South Carolina, 1971

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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I. INTRODUCTION

A. THESIS OBJECTIVE

The purpose of this research project is to examine and document the recording of cost associated with depot level maintenance and the subsequent reporting of these costs by the depot maintenance system to Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics (OASD). The intent is to determine if the data submitted by maintenance depots fulfills the requirements of Department of Defense uniform cost accounting and if this information provides relevant, useful and timely information to the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics to meet Department of Defense and higher level management decision needs. This project will examine the cost accumulating and reporting procedures used by the Sacramento Army Depot, Sacramento, California. At the request of the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics, this project will focus on report RCS DD-M(A) 1397 as a specific instance of reports compiled by OASD from depot level data.

B. HISTORY OF THE PROBLEM

The Department of Defense (DOD) has attempted, since 1963, to establish a uniform cost accounting and reporting

system which would apply to all service depot level maintenance activities. This uniform system was deemed necessary for two reasons. First, there was a wide variety of accounting practices and procedures in use across and within the services. Second, the aggregated costs for repair, overhaul and maintenance of Department of Defense weapons and support systems reported by depot maintenance activities were not meaningful. In 1972, the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics chartered the Joint Logistics Commanders (JCL) panel, whose purpose was to develop and promulgate a uniform depot maintenance cost accounting manual. The results of this panel's efforts were published under the sponsorship of the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics (Management Systems) as Department of Defense Instruction 7220.29 "Guidance for Cost Accounting and Reporting for Depot Maintenance and Maintenance Support Cost Accounting and Production Handbook", October 21, 1975. The target date for the implementation of this new system was October 1, 1976.

Specifically, the objectives of the uniform accounting and reporting system follows:

1. To establish a uniform cost accounting system for use in accumulating the costs of depot maintenance activities as they relate to the weapons systems supported or items maintained. This information would enable managers

to compare unit repair costs with replacement cost and would identify total cost of maintenance by program element and weapon system.

2. To assure uniform recording, accumulating and reporting on depot maintenance operations and maintenance support activities so that comparison of repair costs can be made between depots and commercial contract sources performing similar maintenance functions.

3. To assist in measuring productivity, developing performance and cost standards and determining areas for management support activities for efficient resource use.

4. To provide a means of identifying maintenance capability and duplication of capacity and indicating both actual and potential areas for interservice support of maintenance workload. (GAO, May 1978)

For a multitude of reasons ranging from insufficient Department of Defense guidance to inadequate enforcement of guidance policy, progress towards full implementation of a uniform cost accounting system for depot maintenance activities has been extremely slow. According to representatives of the Manpower Installation and Logistics Office of OASD, discrepancies in reporting apparently still exist and to date, the product of the uniform cost accounting and reporting system ("Maintenance Cost and Production Report (RCS DD-M(A) 1397")) is of questionable value. Theoretically, this report should furnish the Office of the Assistant

Secretary of Defense for Manpower, Installation and Logistics with statistical data that would allow comparisons of world-wide Department of Defense depot maintenance costs and subsequent identification of areas of inefficiencies within the depot maintenance infrastructure. (Defense Audit Service Report, April 1981).

This study begins with a brief background of the Army's maintenance system and focuses specifically on the mission, facilities and capabilities of Sacramento Army Depot and further addresses its organizational structure (in particular, the maintenance department) and how this particular department fits into the greater depot maintenance system. The next step is to trace selected items through the repair/overhaul process at Sacramento Army Depot to identify how their cost accounting system accumulates and reports associated costs. The resulting cost data is examined in light of existing Department of the Army reporting requirements as well as those requirements established by Department of Defense Instruction 7220.29-H. An analysis of cost data as reported by comparable Army Depots for the repair of like items is also presented. The last section presents the major findings and conclusions of the study and offers recommendations for solving specific problems. The results of this study and other concurrent studies at the Sacramento Air Logistics Center, Sacramento, California and the Naval Air Rework Facility, Jacksonville, Florida, are part of a

larger study to evaluate depot level reporting to the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics.

II. DEPOT MAINTENANCE IN THE ARMY

A. SCOPE AND MANAGEMENT OF ARMY DEPOT LEVEL MAINTENANCE

The purpose of this section is to discuss the Army's depot level maintenance structure, how work is distributed throughout the various depot activities and how the Sacramento Army Depot fits into the overall Department of the Army maintenance program.

Depot level maintenance within the Department of the Army has been delegated to the U.S. Army Material Development and Readiness Command (DARCOM). This command operates through Major Subordinate Commands and directs the activities of depots, laboratories, arsenals, maintenance shops, proving grounds, test ranges and procurement offices throughout the U.S. Overall Army maintenance policy is promulgated by DARCOM. The Major Subordinate Commands serve as mid-level managers for the Army's weapons systems programs and the individual depots accomplish the actual execution of the Army's material program. Within the DARCOM organization there are eleven Major Subordinate Commands, twelve maintenance depots and seven depot activities. Figure 2-1 shows a summarized organization chart of the relevant commands. The seven Major Subordinate Commands (MSC) pertinent to this study and their functions are as follows:

- (1) Tank-Automotive Command (TACOM): Located at Warren, Michigan, TACOM is responsible for development, procurement, distribution and support of all tracked and wheeled combat, tactical and general purpose vehicles.
- (2) Armament, Munitions and Chemical Command (AMCCOM): Located at Rock Island, Illinois, AMCCOM is responsible for providing and performing life cycle management of research and development, engineering, procurement and material readiness functions for (a) conventional and nuclear weapons, (b) ammunition (c) fire control systems, (d) chemical warfare and chemical biological defensive systems/material.
- (3) Aviation Systems Command (AVSCOM): Located at St. Louis, Missouri, AVSCOM was officially established March 1984 and is responsible for research and development and material readiness of all Army air frames.
- (4) Troop Support Command (TROSCOM): Located at St. Louis, Missouri, TROSCOM was officially established March 1984 and is responsible for research and development and material readiness associated with troop support; e.g. clothes, food, warfare protection.
- (5) Communications-Electronic Command (CECOM): Located at Fort Monmouth, New Jersey, CECOM is responsible for development and acquisition of command, control

and communications systems and the support of these systems in the field.

- (6) Missile Command (MICOM): Located at Redstone Arsenal, Alabama, MICOM is responsible for the Army's missile and rocket program, including research, development, procurement and continued support of weapons systems once they are operational.
- (7) Depot Systems Command (DESCOM): Located at Letterkenny Army Depot, Chambersburg, Pennsylvania, DESCOM operates as a maintenance coordinator and intermediary between the above six Major Subordinate Commands and the Army's twelve maintenance depots. (DARCOM, September 1980)

DARCOM is organized along functional lines (see Figure 2-1) with all Major Subordinate Commands holding equal rank and reporting directly to DARCOM. As explained in the remainder of this report, the interaction between the six pertinent Major Subordinate Commands, DESCOM and the various depot maintenance activities represents the heart of the Department of Army's maintenance program. The Major Subordinate Commands are responsible for:

- (1) Identifying all depot level maintenance requirements.
- (2) Ensuring adequate supply parts are available (either in the Army supply system or via short lead time vendor contracts) to support both an item in the field and items undergoing depot level maintenance.

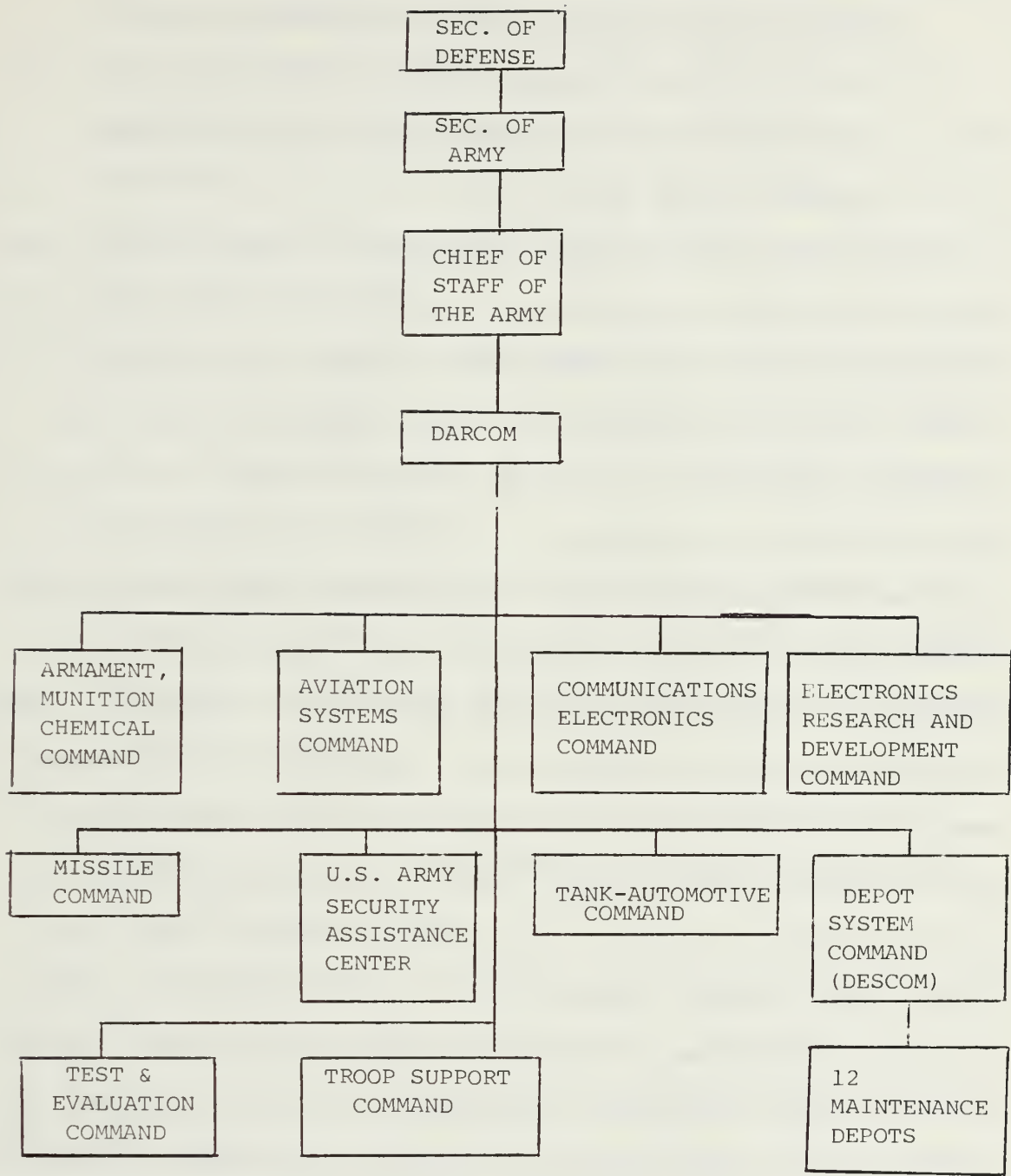


Figure 2-1. Organization Chart for Army Maintenance System.

SOURCE: Adapted from Public Affairs Documentation from Department of the Army Material Readiness Command.

- (3) Developing a Repair Parts and Special Tool List and Depot Maintenance Parts Requirements List for use by the maintenance depots (this is particularly important for newly introduced weapons systems).

(DARCOM, July 1982)

Depot level maintenance requirements identified by the Major Subordinate Commands are submitted to DESCOM via an instrument known as a Procurement Request Order Number (PRON), which is essentially a work request or job order (DARCOM, July 1982). PRON's, along with what is known as the Operational Plan Summary (OPS-25), a series of forms used by DESCOM to establish the program element maintenance requirements of program managers, are used by DESCOM to develop a five-year maintenance program for the Army. This five-year program is updated on a more or less continuing basis and twice a year is submitted to depot maintenance activities in magnetic tape form. This tape provides long range planning guides for each depot (DARCOM, July 1982). As has been stated, DESCOM acts as an intermediary between the Major Subordinate Commands (those who need work done) and the depot activities (those who have the resources and do the work). The following functions performed by DESCOM are considered the most pertinent to this report given that the purpose of this report is to examine cost accumulation and reporting to OASD. Additional functions are listed in DARCOM Regulation R750-28 and for reasons of brevity are omitted here.

- (1) Designates primary and secondary repair facilities. When new weapons systems and/or support systems are introduced, DESCOM will determine which depot activity will have primary and which depot will have secondary (back-up) repair responsibility. Currently, no two depots are designated a primary repair activity for the same item.
- (2) Maintains a central data repository which specifies particulars about each depot maintenance activity (e.g. manpower, floor space, special tools and test equipment available).
- (3) Management and control of overall programming, work-loading and scheduling of depot activity maintenance workloads--ensuring that each depot has a continuous balanced workload.
- (4) Preparing and submitting reports required by Army Headquarters including OASD report RCS DD-M(A) 1397 (DARCOM, July 1982).

The individual depots complete the industrial maintenance chain within the Department of the Army. What follows is a discussion about the Sacramento Army Depot and how this particular depot functions as a part of the Army's maintenance system. This depot was chosen because of its close proximity to the Naval Postgraduate School, Monterey, California, the base from which this research project was conducted.

B. SACRAMENTO ARMY DEPOT

1. Activities and Services

The following information in Sections B.1 and B.2 was obtained from public affairs material furnished by the Sacramento Army Depot Public Affairs Officer and interviews with Sacramento Army Depot personnel. Sacramento Army Depot (SAAD) is one of twelve Army industrial fund maintenance depot activities. It is the primary depot for the repair, overhaul and modification of sophisticated electronic, avionic and night vision equipment. Its average workforce is 3100 people, approximately 60-70 of whom are military. Sacramento Army Depot has 7 directorates which are described below. Maintenance, the primary directorate at Sacramento Army Depot, employs 60 percent of the entire depot work force. Sacramento Army Depot has primary repair/overhaul responsibility for up to approximately 7000 different line items. The depot is normally workloaded for an average of 3000 different line items in any given year. (Powell, May 1984) All directorates contribute to the overall depot mission of "the logistical readiness and sustainability of United States Armed Forces through responsive worldwide support of designated communications-electronic material, central procurement and automated data processing services to designated customers." A simplified organizational structure of Sacramento Army Depot is outlined in Figure 2-2 and is described below.

2. Organization

A brief discussion of each of the organizations directorates follows:

(a). Directorate for Procurement: The Sacramento Army Depot's Procurement Directorate is the major West Coast procuring activity for DARCOM and is the only depot within the Army's depot system with a central wholesale procurement mission. This means that it not only procures supplies and services for Sacramento Army Depot but supports tenant activities, material readiness commands and non-DARCOM agencies (as assigned by the Head Procurement Agency, DARCOM). The Procurement Directorate's major customers include the Combat Development and Experimentation Command, Fort Ord, California, the U.S. Army Korea Procurement Agency and the Television-Audio Support Activity located at Sacramento Army Depot. Procurement support is also provided to Sierra Army Depot, Herlong, California. This Directorate procured 94 million dollars in supplies, services and minor construction work in FY 82.

(b). Directorate for Management Information Systems: This Directorate functions as an automated Data Processing Service Center providing operational support and management information data for (1) Sacramento, Sharpe and Sierra Army Depots in California, (2) the Army Ammunition Plants at Hawthorne, Nevada and McAlester, Oklahoma, and (3) the Crane Army Ammunition Activity at the Naval Weapons Support Center,

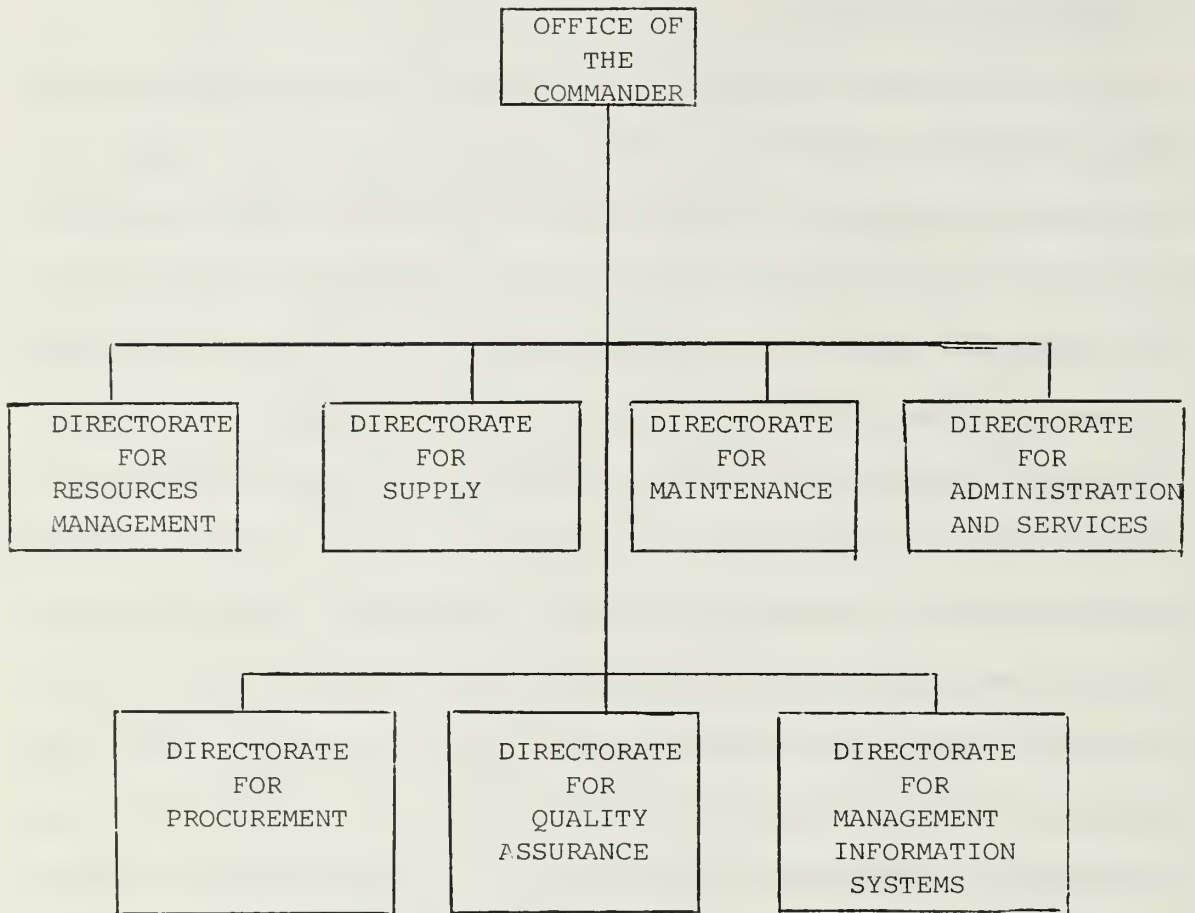


Figure 2-2. Simplified Organizational Structure,
Sacramento Army Depot.

SOURCE: Adapted from Public Affairs Pamphlets Obtained
at Sacramento Army Depot.

Crane, Indiana. This support is provided by means of remote terminal stations located throughout each installation.

(c) Directorate for Resource Management: This directorate is primarily responsible for ensuring proper manpower requirements are calculated to do the depots work. It is involved in productivity improvements, cost reduction, depot modernization as well as budget functions, audit, management analysis and finance and accounting operations.

(d) Directorate for Administration and Services: This directorate is responsible for a multitude of activities such as domestic and community relations programs, Reserve Component training, mobilization, emergency and contingency planning, employee counseling and educational development and monitoring of commercial activities contracts.

(e) Directorate for Quality Assurance: This directorate, comprised of three distinct divisions, conducts test on newly procured or requisitioned raw materials (such as metals, paints and chemicals), provides certification testing of new industrial processes, investigates potential environmental problems, performs in-line and end-item inspections of material being overhauled, repaired or fabricated by the Maintenance Directorate and performs inspections on incoming and outgoing materials to assure acceptable packaging and documentation.

(f) Directorate for Supply: The depot's second major mission area is supply. This directorate is responsible

for receiving, storing, inventorying and shipping wholesale communications electronic material and retail supplies to customers throughout the world. An inventory of approximately 60,000 stock items is maintained with a value in excess of 570 million dollars. In FY 82, this directorate received approximately 200,000 line items and made shipments in excess of 250,000 line items. The Supply Directorate is also the central receiving and shipping point for all depot maintenance work. The supply directorate takes custody of repair/overhaul items when received at the depot. The items are physically inspected to ensure contents match shipping documents. The items are assigned control numbers and stored until called for by the Maintenance Directorate.

(g). Maintenance Directorate: Maintenance is the primary directorate at Sacramento Army Depot. The Maintenance Directorate has the capability to repair, overhaul, test, modify and fabricate sophisticated communications-electronic equipment, electro-optic systems (including infrared detection and night vision equipment), cryogenic devices, (electric motors), communications shelters (self contained field communication units), gyroscopes and teletype equipment. Maintenance Directorate customers are not only various Army commands, but also the Navy and Air Force. Sacramento Army Depot has been designated as one of two DoD communications/electronics centers of technical excellence. As such, the depot is designated as primary repair

facility for a multitude of special current programs such as M-1 Tank thermal imaging systems, laser rangefinders and the Bradley Fighting Vehicle Integrated Sight Unit. To ensure availability of technical skills necessary to work on such sophisticated equipment, Sacramento Army Depot sponsors a threefold training program. The depot trains depot personnel in (1) the fields of basic and intermediate electronics (2) standards of workmanship. They also train Reserve Components, National Guard and selected foreign country representatives under the foreign military sales program.

The Maintenance Directorate is comprised of 67 cost centers supported by three divisions and eleven major branches. The organizational structure is depicted in Appendix A. Work standards are in existence for approximately seventy-five percent of the work performed at Sacramento Army Depot. These standards are locally prepared as they are at every depot and are tailored to incorporate the unique assets and depot characteristics. When work is undertaken on a new project for which the depot has no experience, it can attempt to (1) borrow applicable standards from another depot if available (2) request work performance criteria from DESCOM or (3) attempt to develop engineering standards from existing standards with similar applications.

3. Workloading and Budgeting

As already mentioned, workload is assigned, scheduled and managed by DESCOM. Twice a year DESCOM sends a magnetic tape to Sacramento Army Depot that outlines their prospective maintenance workloading for the next five years. Information extracted from this tape is used for both long range and immediate planning purposes. Proposed workloads are presented to Sacramento Army Depot in two forms. The first is work identified to the depot at a fixed price. That is, DESCOM instructs Sacramento Army Depot what price they charge the customer. The reason for this is to allow DESCOM to balance the overall Army maintenance budget to ensure a year end zero profit for the Army Industrial Fund and to stabilize rates charged to customers within the budget year. When a proposed work order is not identified as fixed price, Sacramento Army Depot reviews the requirements and determines whether to accept, mark up or reject the work order based on funded cost (DESCOM submits a proposed cost to the repair activity along with a proposed work order), depot capability and/or capacity. If the work order is rejected, DESCOM may find another maintenance activity to do the work or may insist Sacramento Army Depot do it. Work order rejections are rare and isolated cases. (Scheller, May 1984) If the work order is marked up, DESCOM may accept the new price and pass the new cost to the

customer providing the new cost does not exceed the standard depot cost limit. This cost limit is referred to as the Maintenance Expenditure Limit (MEL) and is defined as sixty-five percent of replacement cost. Replacement cost is determined by the customer and this figure accompanies the initial work request. If the marked up price exceeds the MEL, the customer must authorize accomplishment of the work request. (Eldridge, May 1984) The point to be made here is that the customers are solely responsible for authorizing work to be accomplished at a price which exceeds the replacement cost.

When a work order is accepted by any maintenance depot, it is classified as a planned work order. Barring any long lead material requirements (as identified by the customer), Sacramento Army Depot focuses the majority of its maintenance planning effort on planned work orders for the budget year (upcoming fiscal year). Sacramento Army Depot projects and submits its budget requirements to DESCOM based on planned workload schedules. Budget development is supported by an extensive historical data base which contains actual cost of production, direct labor required and statistical component replacement data for all items for which Sacramento Army Depot is designated primary and secondary repair activity and have, in fact, repaired. The Maintenance Directorate Financial Manager uses the above information to determine funded labor, funded general

and administrative overhead, funded operational overhead and material rates for each of the directorates' 67 cost centers. Appropriate acceleration (adjustments for employee benefits; e.g. retirement and leave) and inflation factors are then applied to the planned workload. This information is coupled with unfunded General and Administrative and unfunded overhead rates developed by the Directorate for Resource Management, resulting in a budget for the entire depot. (Spaeth, May 1984)

As planned maintenance moves from the budget year into the current year, work orders are received at the depot and converted by computer into a document known as a Program Notice. The Production Planning and Control (PPC) Division of the Maintenance Directorate establishes production flow and cost center workload scheduling. If the items to be repaired/overhauled have arrived at the depot, PPC (with concurrence of the Shops Division) establishes induction timetables, i.e. when the items are physically delivered to the Maintenance Directorate. The Production Engineering Division then determines and lists appropriate engineering specifications and test equipment required to process the work through the shops. The required inspection points are then jointly determined by the Maintenance and Quality Assurance Directorates. In conjunction with the above, the Requisition Branch of PPC reviews historical tables (mortality tables) to determine what replacement parts are necessary

to support the planned work order. These tables are basically weighted average figures that represent what past contracts required in the way of parts replacement. When the amount of expected replacement parts are determined (on a per item basis; i.e. number of resistors, circuit boards, etc. for a radio set) by Production Planning and Control, the figures are presented to the Shops Division of the Maintenance Directorate for review and are then adjusted as mutually agreed upon by the two divisions. The parts requirements are then submitted for procurement via the Army Stock Fund Account. This is separate funding from the Industrial Fund Account and does not represent any charges or commitments to the customers that have requested the maintenance action. (Siegel, May 1984)

Planned maintenance becomes authorized maintenance when Program Notices are received and cite funding authority. That is, when money is actually authorized by DESCOM for expenditure, the depot is permitted to begin the actual repair/overhaul action. As a guideline, DESCOM authorizes the maintenance workload 45 to 60 days ahead of the planned induction schedule. This authorization is based on the induction schedules furnished to DESCOM by Sacramento Army Depot and similar notification that the reparable assets have been received at the maintenance activity.

III. PRODUCTION FLOW AND COST ACCUMULATION

Section II describes the process of workload distribution and the interaction of DESCOM, the Major Subordinate Commands and depot maintenance activities up to the point of delivery of reparable assets to the depot and the authorization for the depot to expend funds to perform the required maintenance. This section discusses maintenance induction at Sacramento Army Depot and describes the production path for a selected reparable item. The information contained in this section was derived from interviews with Sacramento Army Depot personnel cited in Section II. This section also includes a discussion about how cost are accumulated and assigned throughout the repair/overhaul process. An ARC 114 Radio transceiver was chosen as a representative reparable item for which conclusions could be drawn with respect to the production flow process at Sacramento Army Depot. The ARC 114 was selected by Sacramento Army Depot personnel who were assisting in this research project. They had been asked by the researcher to choose an item being reworked at the time of the interview and one with a relatively uncomplicated repair process.

A. PRODUCTION PREPARATION

The production flow for each maintenance action begins well before the actual induction of reparable assets into

the Maintenance Directorate (induction refers to the point in time in which the reparable asset is actually in the possession of the Maintenance Directorate). In anticipation of undertaking a specific workorder, the Production Planning and Control Division in conjunction with the Production Engineering Division develops a comprehensive planning model to establish in-house workload schedules. Production Planning and Control details the actual workload requirements of the various shops and specifies required inspection points. The Production Engineering Division specifies the optimum sequencing of the anticipated workorder and packages and forwards to each applicable cost center the technical specifications necessary to complete the required maintenance. This technical specification package includes information such as the inventory price (replacement cost as provided by the customer) of the asset to be worked on, the lead cost center technical repair standards for each involved cost center, time standards for each involved cost center (e.g. time required as compared to an established standard for each cost center to perform its function such as repair, painting and welding) and test equipment required to process the work through the shops. The process can be relatively simple such as for a radio set (depicted in Figure 3-1) with all work done in a workbench style arrangement by one person or complex such as for the repair of a communications shelter (depicted in Appendix B) in which more than one person can be involved in a single process.

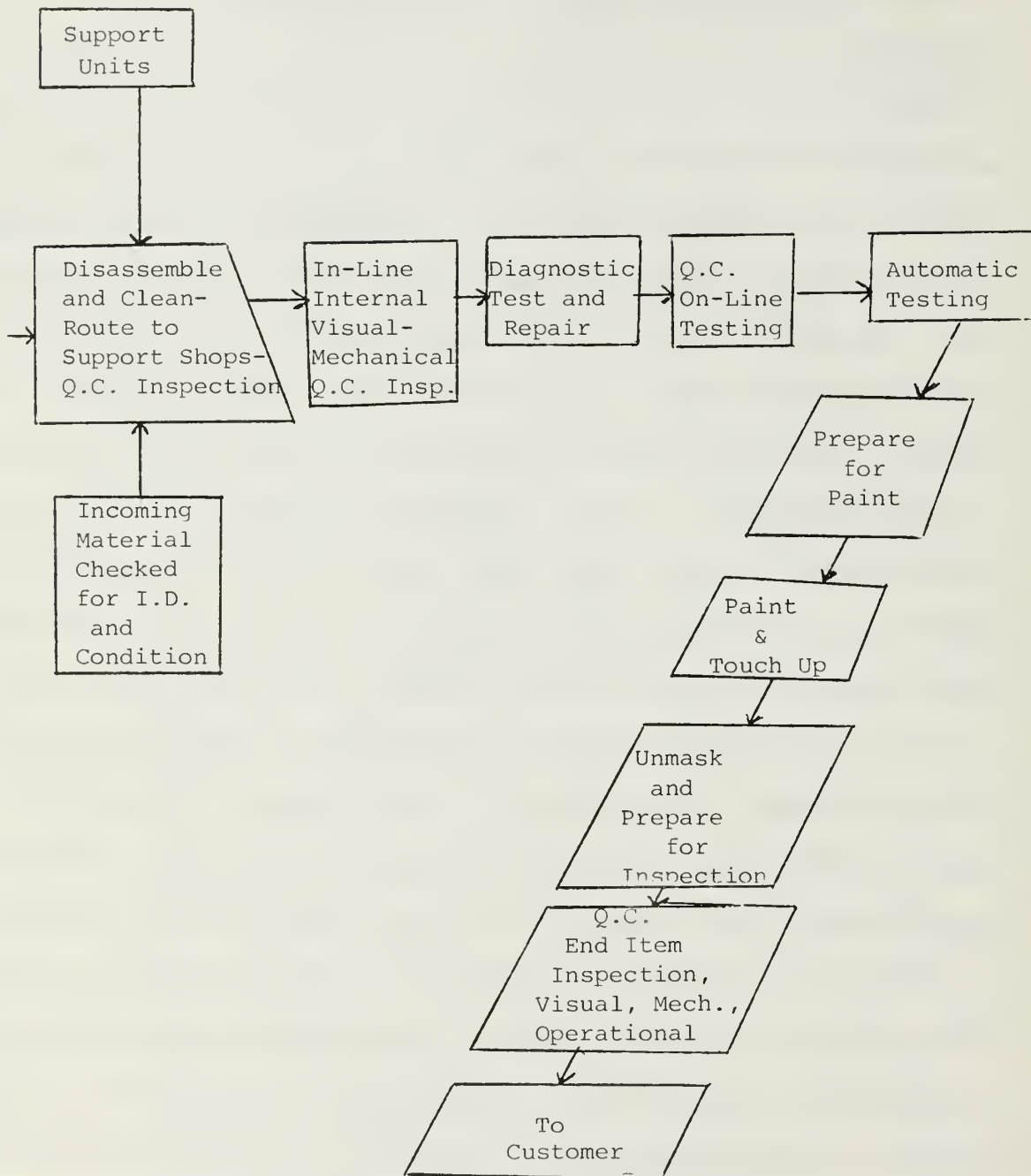


Figure 3-1. Work Flow Process for A/N ARC 114 Radio Set - Sacramento Army Depot.

SOURCE: Provided by Mr. Jim Powell, Production Planning and Control, Maintenance Directorate, Sacramento Army Depot.

B. PRODUCTION FLOW

1. Production Control Number Pertaining to a Particular Joborder

When assets and funds are available to support a repair/overhaul effort and the respective shops are ready to begin the maintenance project, the assets are assigned a local collective control number called a "Production Control Number" (PCN) and are inducted into the Maintenance Directorate. The PCN is the key control element surrounding workorder cost accumulation. All expended man hours, labor costs, material and overhead costs are collected and charged to a Product Control Number without distinction as to customer's DoD component (e.g. Army, Navy, Air Force). This is accomplished via daily input to an established computer program and is discussed later in this chapter. As stated, all charges are collected against all the units of a workorder via the PCN and no provisions are made for identifying costs for an individual unit or reporting such costs (unless a job order consists of only one unit such as a single communication shelter).

2. Shop Repair

As assets arrive at the Maintenance Directorate they are either collected in a central receiving area for inspection or (as more often is the case) delivered directly to the lead maintenance shop. This lead maintenance shop is important as the lead shop supervisor is concerned not

only with ensuring standards are met within that particular cost center, but also that supporting cost centers perform within their prescribed standards. As previously mentioned, time and cost standards are forwarded to each cost center prior to actual maintenance induction with a master standard forwarded to the lead shop. This master standard details how much money and time should be spent on the entire PCN. Deviation from standards at any stage of repair could result in time and cost overruns for which the lead shop supervisor is accountable.

The AN/ARC 114 is one of the majority of items that, when delivered to the Maintenance Directorate, is routed directly to the lead cost center. The first maintenance action for which any changes are made against the assigned PCN is a detailed physical inspection of the received assets by the shop's supervisor and leading man (a wage scale direct labor employee with specialized experience assigned to the cost center). This initial cost center inspection is to determine if the correct assets have been received and the extent of serviceability of the asset (i.e. was only a radio shell received or was basically an intact unit received). If, in the opinion of the shop supervisor, an asset or assets cannot be repaired/overhauled within 65 percent of the replacement cost, the shop foreman submits a Form 370 to Production Planning and Control specifying what is wrong with the received asset and why it cannot be repaired at

standard costs. This report may be used as a basis for requesting additional funds from the customer depending on the severity of the problem. More importantly, this form represents a cost center and depot record which identifies by unit any extraordinary problems encountered (this form is submitted whenever an unusual problem is discovered, not just for reporting initial inspection discrepancies). Also, as each depot activity must report to DESCOM why a maintenance action exceeds prescribed standards, this form often serves as the basis for such explanations. After the initial inspection, the assets are routed to individual workbenches where they are disassembled, cleaned and inspected more thoroughly. Individual components are disassembled and if necessary, routed to support shops for repair. Normally, however, for the AN/URC 114, one worker per unit completes all required mechanical, electrical and electronic work. Throughout the repair cycle, quality control inspections are conducted by Quality Assurance Directorate personnel. These inspections are charged to the PCN as direct labor charges.

During the repair process, any reparable defective components must also meet the 65 percent replace versus repair criteria. That is, if a circuit board is found to be defective, wholesale replacement cannot automatically occur. If the board can be repaired at a cost not to exceed 65 percent of the replacement cost, it is repaired. The

replacement cost information for all Army assets is maintained in the "Army Master Data File" (AMDF). Pricing information in this file is scheduled to be updated on an annual basis. When the necessary repair work is completed, unit testing is accomplished either at a location within the cost center or at a specified support center. In either case, the result is the same with all costs incurred being charged to the Production Control Number assigned to the asset/assets. Repaired assets are then routed to the refinishing center where they are painted and made ready for end item inspection. This is the final quality assurance inspection prior to their return to the Supply Directorate for shipment to the customer.

3. Labor Distribution

As already mentioned, Sacramento Army Depot uses a locally prepared fourteen digit alpha numeric code (Production Control Number) to accumulate costs to any given workorder. Labor costs are accumulated against a workorder by means of a Labor and Production Card (L and P Card). This card physically resembles the 80 column Hollerith Card used in older computer systems to input data. These cards are prepared daily by the administrative section of the Maintenance Directorate for each shop supervisor. The cards contain the prepunched name, social security number and cost center of the individual employees. The supervisor manually fills in the time and PCN for each employee. This

information is then routed at the end of the day to the Directorate for Management Information Services where it is entered into the computer via a key-to-disk tape process. The computer has preprogrammed general information which includes personnel assigned to the depot and their wage rates. As a work program is undertaken, a special computer program is stored for each PCN. When Labor and Production Card data are entered into the computer, workers are matched with wage rates. The information is then assembled for payroll purposes and to allocate PCN time and cost information. At the end of any given day after all L and P Card transactions have been input into the computer, information is available for active PCN's by cost center classified by many man hours expended and labor cost. One note of interest, employees maintain their own monthly production records which detail on which PCN they worked, identification of the particular unit within a PCN (by serial number), how much time they spent on it and what type of work they did. This is an informal record signed by each workcenter supervisor. These records could provide valuable data for cost reconstruction by unit.

4. Material Requisition

Consumed materials, both funded (those purchased through the supply system) and unfunded (those provided by the customer), are identified by Production Control Number and cost center. In any particular cost center, repair

parts requirements must meet the 65 percent repair vs. replacement criteria. If it is determined that replacement parts are warranted, the shop supervisor submits a local requisition form to the requisitioning branch of the Maintenance Directorate. The requisitioning branch runs a computer check to see if the needed parts are available at the Supply Directorate. If available, the requirement is entered into the computer at the same time the charge is made against the PCN specifying the cost center making the charge. The amount charged to a cost center for materials is the price as established in the Army's master inventory pricing catalog. Price updates occur normally only once a year unless the material is obtained directly from a vendor in which case the vendor's price is passed on to the customer. If all material is obtained from the Army Supply System, no distinction is made as to which DoD customer the repair material is for; they are all charged the same price for identical items. Disparities in price could occur if, for example, only one repair item was available in the supply system and needed for two different contracts. In this case, one contract would be charged the supply system price and the other contract would be charged the vendor's price (assuming the needed item was obtained from a vendor). The computer request is used to generate a DD Form 1348-1 requisition which the Supply Directorate uses as authority to draw and issue material. It normally takes one day to receive

requested material; however, provisions are made for walk-through requests. When received materials are not needed for whatever reason, they are turned in as excess to the Maintenance Directorate requisitioning branch where computer entry is made to credit the appropriate cost center. As with labor charges, computer information can be obtained on a daily basis which specifies materials used on each PCN and by which cost center.

5. Overhead Application

As discussed in Section II, Sacramento Army Depot prepares its budget based on expected workload. Direct labor hour requirements for production are calculated and all overhead and General and Administrative rates are determined based on expected/budgeted direct labor hours. Production overhead is categorized as funded or unfunded. The unfunded category is used to account for costs of military personnel working in support of the Maintenance Directorate but who are paid out of other than industrial fund appropriations. Funded overhead includes elements such as cost center supervision, training and maintenance of equipment and tools. There is a separate funded and unfunded rate established for (1) each individual cost center, (2) for the maintenance directorate as a whole and (3) for the depot as a whole. These overhead rates are applied based on direct labor hours. There is also an application of funded and unfunded General and Administrative expenses for

each direct labor hour. There is, however, only one funded and unfunded General and Administrative Expense rate applied. The procedure of application is quite simple. As the computer reads information transcribed from the L and P Card, it automatically applies the respective rates to the number of man hours charged to a particular PCN. It multiplies the man hours times funded and unfunded overhead rates for (1) the cost center, (2) the Maintenance Directorate, (3) the depot and the funded and unfunded General and Administrative rates. At least once each quarter, variance analysis is conducted on overhead rates. Adjustments may be necessary for example, if planned workorders do not materialize. This results in idle capacity in some cost centers and a realignment of some direct costs into the indirect cost category. The point is that if a workorder spans several quarters, it is possible to have several different cost center, Maintenance Directorate and depot overhead rates applied as well as several different General and Administrative rates. For this reason, one cannot review the cost data as received by OASD and derive any meaningful rates for overhead and General and Administrative expenses (i.e. funded overhead divided by direct labor hours does not yield any statistically significant ratio).

6. Automated Cost Accumulation

All direct labor, material costs and General and Administrative and overhead applications are accumulated

and stored by Production Control Number (PCN) on computer tape. Once a week this tape is transmitted via AUTODIN to the Depot System Command Headquarters (DESCOM) and serves as a status report on the respective Procurement Request Order Number (PRON). (The PCN is a local control number unique to Sacramento Army Depot). For local control purposes, the computer produces every other day a "Fund Control Listing" which details the status of the PCN/workorder.

This report specifies:

- (1) which cost center has expended how many man hours
- (2) what the total charges by cost center have been to date
- (3) how many units of the PCN are complete and how many were scheduled to be completed
- (4) how much of the customer's funds are remaining
- (5) percentage of work complete
- (6) what the cost breakdown by funding category is

The Fund Control Listing is just one of the control reports automatically generated by the computer system at Sacramento Army Depot.

The next section takes a closer look at the data received on these operations by OASD and compiled in its Maintenance Cost and Production Report.

IV. OVERHAUL/REPAIR COST DATA ANALYSIS

The purpose of this section is to compare the cost data as submitted by Sacramento Army Depot and received by the Office of the Assistant Secretary of Defense (OASD) in order to determine if data transformations occur and if any bias is created in this process. The depot level data is compiled by OASD for the Army, Air Force and Navy in fourteen different tables (see Appendix C for a listing of the tables prepared). In addition, as a specific instance, this section examines Table 14 of OASD report RCS DD-M(A) 1397 to determine if the data submitted by maintenance depots provides relevant, useful and timely information to OASD to meet DoD and higher level management decision needs.

A. DATA FLOW FROM SACRAMENTO ARMY DEPOT TO OASD

Each DoD component is required to maintain in a central location, a magnetic tape prepared and submitted in the format as specified in DoD Instruction 7220.29-H. This tape is to be updated quarterly on a cumulative basis for provisionally closed completed job orders. The end of the fiscal year tape is submitted within 90 days of the close of the fiscal year to OASD. Roughly translated, within 90 days of the close of the fiscal year, OASD receives cost and production data (in the format specified in DoD

Instruction 7220.29-H) on all completed jobs from all service branches. Within the Department of the Army, submission of cost and productive data is delegated to DESCOM. (Department of the Army, Jan. 1981) As stated in Section II, cost data charged to a Procurement Request Order Number (PRON) is sent weekly by Sacramento Army Depot to DESCOM via Autodin (automated digital network). The format of the data is specified by DARCOM Regulation DARCOM-R 750-28. When a particular job/PRON is completed, the respective cost and production data is submitted by DESCOM to OASD as specified above.

In order to determine if data received by OASD (and subsequently used to develop OASD report RCS DD-M(A) 1397) is the same as reported by Sacramento Army Depot, cost and production data obtained from OASD on eight different items completed at Sacramento Army Depot in FY 82 were analyzed. During a visit to Sacramento Army Depot, historical records were checked on two of the eight items and a comparison of the data were made. The cost as received by OASD and as reported by Sacramento Army Depot were the same on both items checked with one common exception. Also noted were minor differences in classification of particular costs. The following is a breakdown of costs and cost classification as received by OASD from DESCOM and as submitted by Sacramento Army Depot to DESCOM for repair of 50 AN/GRC-106A radio sets in FY 82.

(1) DATA RECEIVED BY OASD IN FORMAT OF DOD INST. 7220.29-H:

Direct Civilian Labor (Production) Cost	14949	(A)
Direct Civilian Labor (Production) Hours	1137	(B)
Direct Civilian Labor (Other) Cost	43	(C)
Direct Civilian Labor (Other) Hours	3	(D)
Direct Material Cost-Funded	3840	(E)
Direct Material Cost-Unfunded	525	(F)
Operations Overhead-Funded	11574	(G)
Operations Overhead-Unfunded	4647	(H)
General and Administrative Expense-Funded	2603	(I)
General and Administrative Expense-Unfunded	988	(J)
Quantity Completed	50	(K)

(2) DATA SUBMITTED BY SACRAMENTO ARMY DEPOT OF DARCOM
REG. 750-28:

Direct Labor Cost Civilian	14897.74	(A)
Direct Labor Man Hours Civilian	1133.75	(B)
Direct Labor Cost Other	42.96	(C)
Direct Labor Hours Other	3.00	(D)
Material Cost Funded	3839.56	(E)
Material Cost Unfunded	525.00	(F)
Industrial Maintenance Expense Funded	11574.64	(G)
Industrial Maintenance Expense Unfunded	4647.77	(H)
General and Administrative Expense Funded	2602.82	(I)

General and Administrative Expense Unfunded	861.90	(J)
Quantity Completed	50	(K)
Overtime Direct Labor Cost	94.55	(L)
Overtime Direct Labor Manhours	6.5	(M)

The difference in cost data is twofold. First, OASD received a figure for Direct Civilian Labor (Production) Cost that was \$51.26 higher than Direct Labor Cost Civilian as reported by Sacramento. This difference is accounted for by Overtime Direct Labor Cost (L) minus Direct Labor Cost Other (C) as reported by Sacramento. Second, Unfunded General and Administrative Expense as received by OASD is \$126 higher than reported by Sacramento. This difference is explained below and is the common exception mentioned above. The other set of historical records checked at Sacramento Army Depot revealed that General and Administrative Expense Unfunded was received by OASD at an amount \$162 higher than reported by Sacramento Army Depot. This discrepancy in both situations is explained by the fact that DESCOM adds a "command charge" to all G and A expenses (unfunded) of 0.8 percent for each contract/PRON based on direct labor cost. (Fogelsanger, May 1984)

B. EXAMINATION OF TABLE 14, OASD REPORT RCS DD-M(A) 1397

Table 14 was chosen for evaluation in preference to the remaining 13 tables comprising OASD Report RCS DD-M(A)

1397 because OASD Table 14 represents a logical conclusion to tracing the accumulation and reporting of costs by maintenance depots. OASD Table 14 is a listing of items reworked at more than one facility with an aggregate cost of greater than fifty thousand dollars. This table offers a comparison of unit maintenance costs between rework facilities who do the same category of work on identical items. As explained below, this data, taken at face value, has potential for misinterpretation.

In FY 82, according to OASD Table 14 data, Sacramento Army Depot had 19 contracts for rework of items identical to items reworked at another facility. Reported cost differences between Sacramento Army Depot and its "competitors" ranged from as great as \$823,000 per unit to no difference at all. To the casual observer, it might seem that the \$823,000 price per unit differential was excessive. This represents but one instance of where OASD Table 14 data can be misinterpreted. As it turns out, the item with the \$823,000 price differential was in fact a bulk pack. That is, a conglomeration of numerous items for which the costing category represents a pool of funds for rework of general category items. As already mentioned, Sacramento Army Depot apparently had 19 contracts to rework items identical to those at another facility. Table 4-1 is a list of those items extracted from FY 82 OASD Table 14 data.

TABLE 4-1

ITEMS FROM FY 82 OASD TABLE 14
REWORKED BY MORE THAN ONE FACILITY

ITEM I.D. CODE	FACILITY	UNIT COST
(1) B14ASFBULK	ANNISTON AD	29,399
	SACRAMENTO	22,954
	MAINZ	845,525
(2) G849	SACRAMENTO	7,875
	AEN	14,737
	AEN	1,313
(3) G869	SACRAMENTO	15,081
	AEN	15,600
(4) 5820AFRTBLK	SACRAMENTO	140
	CERCOM CMN	10
(5) 5820MISCRPR	SACRAMENTO	259
	TOBYHANNA	259
(6) 9999AFRTBLK	SACRAMENTO	1,267
	CERCOM DMM	516
(7) 6665DOSIMTR	SACRAMENTO	2.63
	RED RIVER	4.17
(8) 6665RCCSERO	SACRAMENTO	7.80
	RED RIVER	42.17
(9) 4120005924645	SACRAMENTO	170
	NEW CUMBERLAND	289
(10) 5820009733384	SACRAMENTO	260
	TOBYHANNA	296
(11) 5826009997143	SACRAMENTO	745
	CERCOM	257
(12) 5805008778740	SACRAMENTO	43,497
	TOBYHANNA	18,627
(13) 5805009451075	SACRAMENTO	84
	TOBYHANNA	98

(14)	5820001848376	SACRAMENTO	143
		TOBYHANNA	200
(15)	5820002237548	SACRAMENTO	783
		TOBYHANNA	457
(16)	5820004442328	SACRAMENTO	174
		TOBYHANNA	133
(17)	5820005033960	SACRAMENTO	1,718
		TOBYHANNA	1,024
(18)	5821009977924	SACRAMENTO	142
		TOBYHANNA	203
(19)	66250106804	SACRAMENTO	70
		TOBYHANNA	59

NOTE: CERCOM represents commercial contracts.
 AEN is the old name for what is now The Troop Support
 Command and the Aviation Systems Command.

Source: FY 82 OASD Table 14

The last eight items of Table 4-1 were chosen for an indepth analysis with the intent to explain why there was a cost difference from one repair activity to another performing what appears to be the same work on identical items. All of these items involved Sacramento and Tobyhanna. The first eight items were not analyzed because they do not represent identical items. Anything less than a thirteen number item identification code means the item is not specifically identifiable. That is, 4 and 5 alpha numeric identification numbers means the items are not identical. These numbers could, in fact, stand for an activity such as the cost of installing a communications switchboard or the cost of sending a technical representative to a field location. The

point is that anything less than a 13 digit identification number represents dissimilar items.

In order to gain a better understanding of why there were rework cost differences between Sacramento and Tobyhanna (items 12-19 above), available cost data for the period FY 78 through FY 82 was obtained from OASD. The intent was to establish a 5-year time plot to identify cost trends associated with each of the respective maintenance depots. What was discovered upon receipt of data from OASD was that a time plot is of limited value because like items are not consistently repaired at more than one maintenance depot. An example is item (14). Although Tobyhanna completed seven contracts over a four-year period (79-82), Sacramento completed only one contract and that was in FY 82. Nearly the reverse is true for item (15) in that Sacramento completed four contracts over a three-year period (80-82) but Tobyhanna completed only one over the same time span in FY 82. Items (12) and (18) are further broken down in Tables 4-2 and 4-3 to show where the differences in costs occur and to further demonstrate the vulnerability of OASD Table 14 as a decision tool.

Table 4-2 represents costs associated with the overhaul of a selected piece of communications equipment. FY 82 data indicates Sacramento's cost per unit was \$43,497 and Tobyhanna's was \$18,628, a difference of \$24,869. The primary reason for such a large difference is explained by

TABLE 4-2

SACRAMENTO AND TOBYHANNA OVERHAUL
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-82	4-82	3-79	3-79
ITEM I.D.	5805008778740			
NOMENCLATURE	AN/TCC-60 TEL TML			
STD INVENTORY PRICE	48488			
WORK TYPE	OVERHAUL			
CUSTOMER	ARMY			

FACILITY	SACRAMENTO	TOBY.	SACRAMENTO	TOBY.
DIR CIV LABOR (PROD)	20074	327652	14744	15808
DIR CIV LABOR (OTHER)	0	14255	0	0
DIR MATL (FUNDED)	1904	71230	662	2341
DIR MATL (UNFUNDED)	0	11950	254	7822
OPERATIONS OVHD (FUNDED)	14845	213696	12896	8601
OPERATIONS OVHD (UNFUNDED)	3497	14669	4745	1172
GEN & ADMIN (FUNDED)	2525	45536	447	3279
GEN & ADMIN (UNFUNDED)	<u>652</u>	<u>8863</u>	<u>403</u>	<u>478</u>
TOTAL COST	43497	707851	34151	39501
QTY COMP	1	38	2	2
TOTAL DIR HRS	1476	30980	1302	1805
DIR HRS PER UNIT	1476	815.26	651	902.5
UNIT REPAIR COST	43497	18627.66	17075.5	19750.5

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation and Logistics)

TABLE 4-3

SACRAMENTO AND TOBYHANNA OVERHAUL
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-82				
ITEM I.D.	5821009977924				
NOMENCLATURE	AMPLIFIER F/ARC-131				
STD INVENTORY PRICE	1390				
WORK TYPE	OVERHAUL				
CUSTOMER	ARMY	NAVY	NAVY	ARMY	ARMY
FACILITY	SACRAMENTO	TOBY.	TOBY.	TOBY.	TOBY.
DIR CIV LABOR (PROD)	4551	3226	556	5812	9304
DIR CIV LABOR (OTHER)	17	109	0	183	195
DIR MATL (FUNDED)	741	477	0	4552	519
DIR MATL (UNFUNDED)	0	0	0	0	0
OPERATIONS OVHD (FUNDED)	3468	2122	333	3034	6603
OPERATIONS OVHD (UNFUNDED)	1228	75	16	227	216
GEN & ADMIN (FUNDED)	832	356	17	714	1079
GEN & ADMIN (UNFUNDED)	<u>145</u>	<u>77</u>	<u>12</u>	<u>143</u>	<u>219</u>
TOTAL COST	10982	7442	984	14035	18135
QTY COMP	77	30	6	58	100
TOTAL DIR HRS	333	292	50	482	838
DIR HRS PER UNIT	4.32	9.73	8.33	8.31	8.38
UNIT REPAIR COST	142.62	248.06	164	241.98	181.35

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation and Logistics)

labor costs. Tobyhanna's labor cost per unit was \$8,622 (vice \$20,074 for Sacramento). However, Sacramento completed only one unit and Tobyhanna completed 38. This suggests that, at least to some degree, maintenance depots are able to apply economies of scale to industrial activities. This is perhaps more apparent when data is analyzed for the same type of work completed by these depots in FY 79. Here both depots overhauled two each of the communications equipment. The unit cost difference is approximately \$2,700 (vice \$24,869 for those items completed in FY 82). Sixty percent of the total cost difference can be explained by material cost. The remainder of the difference is explained by the time (labor costs) required for the two depots to complete their respective jobs. The material cost difference can significantly distort the cost per unit from one depot to another and for different contracts within the same depot. For example, the Tobyhanna FY 82 data in Table 4-2 is actually comprised of 4 separate contracts (this breakdown is not displayed in Table 4-2 but is in Table 4-3). The aggregate cost of material used per unit is \$2189. The material cost per unit actually ranged from a high of \$2,554 on one contract to a low of \$737 on another contract. The point is that a large portion of the cost to repair or overhaul an asset can vary from contract to contract depending on material used and is outside the control of the maintenance activity. If the assets received for maintenance

are in fairly good condition, rework cost consists primarily of labor, overhead and administrative expenses and costs are relatively uniform within a given depot. If, on the other hand, assets are received with parts missing or broken chassis, the rework cost per asset is significantly higher.

Table 4-3 is an example of multiple contracts within a given period. As can be seen, the cost per unit varies. Looking specifically at Tobyhanna, the variance of cost per unit is tied directly to material usage and labor hour differential. If the material cost for the first three contracts from the right are excluded, the maximum difference in overhaul cost per unit would be \$12.66. The Tobyhanna contract in the second column from the left has the higher cost per unit and this higher cost is attributable to a greater number of direct labor hours required per unit to complete the required overhaul. For this particular item, over a 4-year period (FY 79-82), Sacramento completed 6 overhaul contracts for a total of 620 units. The direct labor hours required per unit ranged from a low of 2.87 (FY 79 contract) to a high of 5.53 (FY 80 contract). Tobyhanna completed 4 contracts for a total of 194 units, all in FY 82. The direct labor hours per unit ranged from a low of 8.31 to a high of 9.73.

It appears that Sacramento has overhauled more of these amplifier units and owing to the learning curve phenomena,

are more efficient in completing the overhaul with respect to direct manhours per unit. This may or may not be the case. As mentioned in Section II, each depot establishes its own repair and overhaul work standards based on its own unique characteristics (work area layout, test and repair equipment available, etc.) and upon the average condition of the assets upon receipt at the depot. The point is that, like material costs, labor hours per unit may vary depending on the condition of the asset upon receipt at the depot. This is especially true when considering repair action. There are no reporting procedures established which disclose the extent of repair effort necessary on a repair contract. That is, it is impossible to tell from one contract to another, from one depot to another (other than labor hours expended) or from one OASD report to another what the condition of the asset was upon receipt and the extent of repair effort needed to restore the asset to a serviceable condition.

Besides direct labor hours per unit and material costs, the labor cost per hour is another reason why costs vary from one depot to another. In FY 82, aggregate civilian labor costs per hour were \$13.40 at Sacramento and \$11.05 at Tobyhanna. Civilian wage rates for industrial workers are set by Government service wage scale requirements and are not controllable by individual depots.

As a point of interest, OASD Table 14 for Tobyhanna does not match the cost information received from OASD for the assets described in Table 4-3. The Navy contracts are excluded from OASD Table 14 analysis for unknown reasons. Appendix D represents the remainder of cost breakdowns for FY 82 OASD Table 14 data and are included for information purposes only. The above comments for Tables 4-2 and 4-3 apply equally to this appendix.

The next section addresses the conclusions reached as a result of this research project and outlines specific recommendations.

V. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This section presents the conclusions and recommendations based on the findings of this study of depot maintenance cost reporting. Included in this section are specific recommendations about OASD Table 14 and some suggestions for areas of further study.

A. DEPOT LEVEL FINDINGS AND CONCLUSIONS

Cost data submitted by Sacramento Army Depot to DESCOM and consequently to OASD meets the reporting format requirements of DoD Inst. 7220.29H. There are some differences in the reporting format submitted by Sacramento Army Depot to DESCOM. DESCOM transforms the data into the format required by DoD Inst. 7220.29H and in addition, adjusts depot level General and Administrative Expenses upward by 0.8 percent. This is a consistent practice within the Department of the Army and is the only systematic bias discovered in the reporting system.

The cost information received by OASD is, however, not timely. Cost data is reported to OASD only when a contract has been completed. This procedure may tend to distort the actual maintenance cost associated with any given program in a given year. If, for example, a contract is started in May 1983, and is completed in December 1983, the costs

would not be reported to OASD until approximately December 1984. All the costs would be reflected as FY 84 costs and none would have been assigned to FY 83. The significance of this time delay is dependent upon the required accuracy of how much each DoD program spends on maintenance each year. If long term simple averages (10 years, for example) are acceptable, then the present method of reporting costs is acceptable. If, on the other hand, OASD requires cost data associated with program maintenance as of a specific date (e.g. end of the fiscal year), then the present system of cost reporting is inadequate. The decision to introduce time sensitive accounting methods that incorporate equivalent unit maintenance and work-in-progress accounting into OASD Report RCS DD-M(A) 1397 must be weighed against the costs and time delays to implement such an accounting process. Given that the present system is already eight years past due for full implementation, one can argue that any revised procedures with respect to cost accumulation and reporting would encounter equal, if not greater, difficulty being accepted by the service components. A follow-on recommendation to this topic is presented in Section V.D (4).

B. OASD TABLE 12

One area not specifically addressed in the body of this report but relevant to the interests of OASD personnel, is OASD Table 12 which specifies items maintained in excess of

100 percent of standard inventory price. In its present format, OASD Table 12 is misleading. It implies individual depots are repairing and overhauling items without consideration of the cost than would be incurred to replace them, and this in turn implies managerial inefficiency at the depot level. Section II of this report discusses the checks and balances used at Sacramento Army Depot to ensure repair costs do not exceed the standard inventory price. Section II further points out that any decision to spend maintenance funds in excess of the standard inventory price is made by the customer having responsibility for the items being reworked. It is not the decision of the depot performing the work. This is true for the entire asset as well as individual repair parts used in repairing or overhauling the asset. From discussions with personnel at Sacramento Army Depot and DESCOM, the customer may decide to rework an item which exceeds replacement cost because of the following reasons:

- (1) The standard inventory price and replacement price are not always the same. The inventory price published in the Army Master Data File (AMDF) may be outdated.
- (2) It may be cheaper to replace an item but the needed item might not be available within the time required.

Recommendation (1): include a narrative section with each cost report submitted to OASD that gives reasons for any repair versus replacement excesses and include this explanation in OASD Table 12. Specific follow-on study recommendations are included in Section V.D (5).

C. OASD TABLE 14 FINDINGS AND CONCLUSIONS

The purpose of OASD Table 14 is to display those items repaired at more than one facility with a total cost of at least \$50,000. In its present form, OASD Table 14 does not meet this objective because it also includes data for unlike items. OASD Table 14 also compares dissimilar work accomplished on homogeneous systems such as a ship or a tank. According to Sacramento Army Depot and DESCOM personnel, only items assigned a thirteen digit identification number should be compared for duality. Anything less than a thirteen digit code means the items are not specifically identifiable.

Recommendation (2): OASD Table 14 comparisons should be made only for items with identical thirteen digit identification numbers.

The greater the number of identical items per contract, the greater is the possibility that a maintenance depot can take advantage of economies of scale. This is especially true if some of the rework costs are associated with setting up and reconfiguring test equipment and work areas for specific contracts. A depot that reworks only one item in a contract is unable to spread one time costs over several products. This depot would not appear to be as efficient as another depot reworking more than one of the same items. Although the comparison may be useful, it is misleading when included as part of OASD Table 14.

Recommendation (3): Exclude from OASD Table 14 comparisons of a depot that reworked only one unit of an item to a depot that reworked more than one of the same item.

OASD Table 14 for any given year represents only a snapshot of items reworked at more than one maintenance depot. From a single year's data, a determination cannot be made as to whether or not the items are consistently repaired at more than one depot. Examining data provided by OASD showed there is little consistency in items reworked at more than one facility. In order to make cost comparisons meaningful, the comparisons should span several time periods.

Recommendation (4): Include only those thirteen digit items in OASD Table 14 that have been consistently reworked at more than one depot for two or more years.

Recommendation (5): Create an additional table (OASD Table 14A) that presents a history of the rework costs associated with the items identified in OASD Table 14.

The informative data contained in OASD Table 14 are those reflecting (1) that an item was repaired at more than one depot, (2) the total quantity completed at each depot and the associated cost incurred by each depot. One should not compare depot costs per unit reworked and draw conclusions with respect to individual depot efficiencies. To do so infers the repair or overhaul process is analogous to assembly line procedures with conditions at all maintenance activities being equal. This is not the case. The following reasons (outside the control of the depot explain why rework costs vary between depots and between contracts within the same depot:

- (1) Labor wage rates differ from one depot to another.
- (2) Repair and overhaul standards are different at each depot. This means that time standards will also vary between depots.
- (3) Overhead cost will be different for each depot. These differences can be compounded if contracts are lengthy and if for some reason depot work does not materialize resulting in unforeseen adjustments to overhead. This means there is little consistency in overhead costs and where one depot may have higher overhead costs than another depot in a given year, the reverse may be true for the next year.
- (4) Material costs for reworking items are dependent upon the conditions of the item when it arrives at the depot. Material costs vary from contract to contract and depot to depot.

Sacramento Army Depot repairs approximately 3000 different line items annually. Data from FY 82 OASD Table 14 indicates 11 items identified with a 13 digit identification number were also repaired at another depot. It is questionable if this small percentage of duality (0.004%) would form the foundation for decision making at any level within the Department of Defense.

Recommendation (6): In view of the small percentage of items repaired at more than one depot and the variations in cost associated with those items that are repaired at more than one depot, an examination of the need for and possible format revisions in Table 14 should be considered.

D. RECOMMENDATION FOR FOLLOW-ON STUDY

The following are suggestions for additional research to enhance the scope of this report.

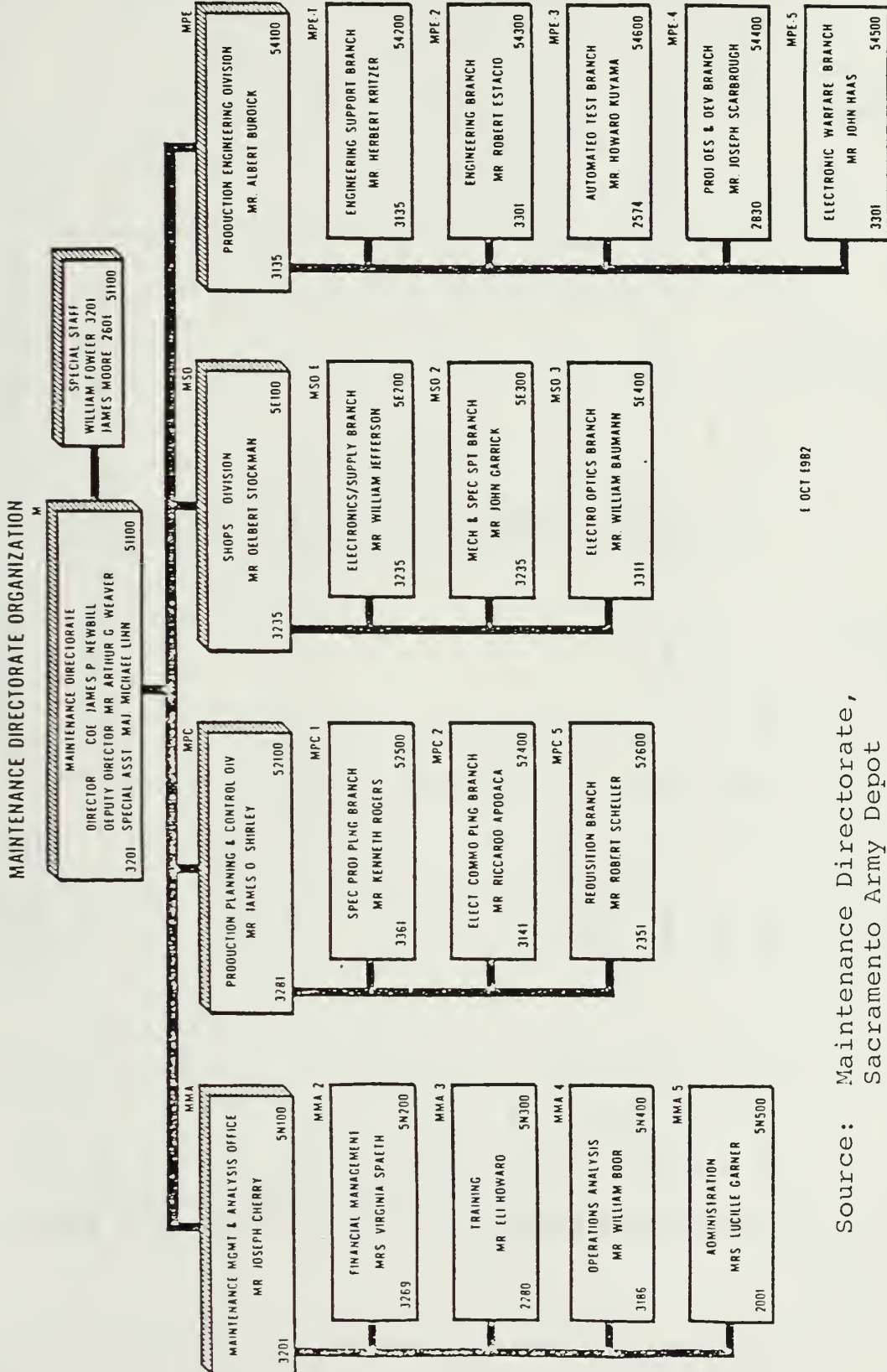
- (1) Conduct a survey of Army depot level reporting requirements in an attempt to determine if the data required by DoD Inst. 7220.29H is also required by some other reporting system.

- (2) Study the benefits and burdens of submitting the cost data required by DoD Inst. 7220.29H for each DoD component. Would the services require maintenance depots to report any differently if DoD Inst. 7220.29H was cancelled?
- (3) Within the Army's Major Subordinate Command organizations, are personnel referred to as Item Managers? What is their function and how do they interact with depot maintenance activities?
- (4) Conduct a study to determine the costs and benefits associated with the service components reporting equivalent unit maintenance and work-in-progress accounting.
- (5) OASD Table 12 could be revised to include a narrative section that would permit explanation of maintenance costs which exceeded standard inventory price. The particulars about the contents of the narrative section could be included in any study conducted on OASD Report RCS DD-M(A) 1397.
- (6) Section III.B (4) stated that adjustments to overhead rates are necessary if planned workorders do not materialize. Determine in greater detail the effect on maintenance depots when workorders are cancelled.

In conclusion, this study was an attempt to determine the extent to which various depots use uniform cost accounting procedures and provide valid data to OASD. The study suggests that while there may be problems in depot level data accumulation, they are not (if Sacramento is representative) of any serious proportion. A problem which does exist is the disconnection between the depot data and its final compilation by OASD. It seems that the format of many of the current reports provides information which may be misleading or subject to misinterpretation. A better communication between users and providers of this data may alleviate some of the current problems.

APPENDIX A

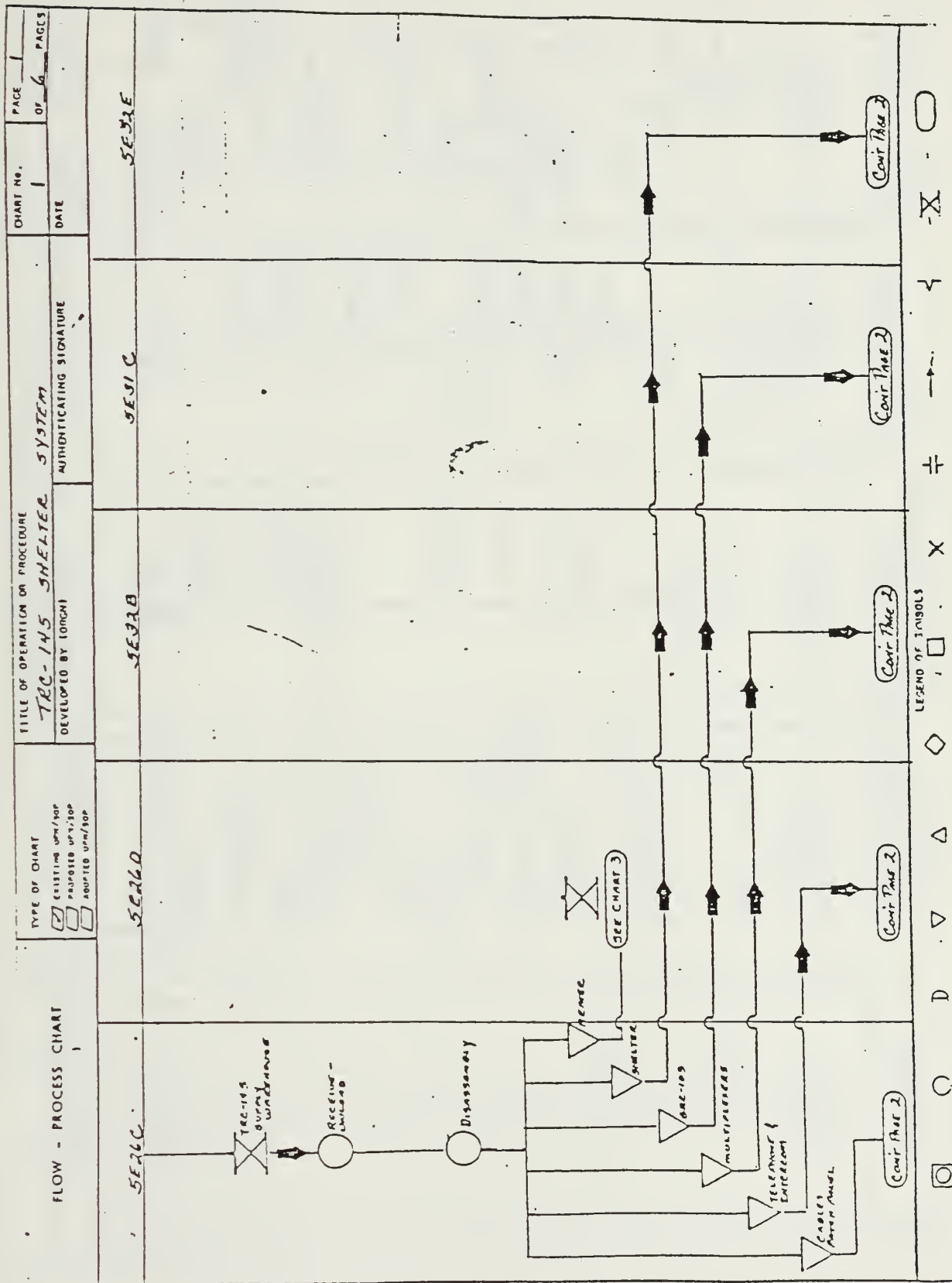
SACRAMENTO ARMY DEPOT MAINTENANCE DIRECTORATE ORGANIZATION

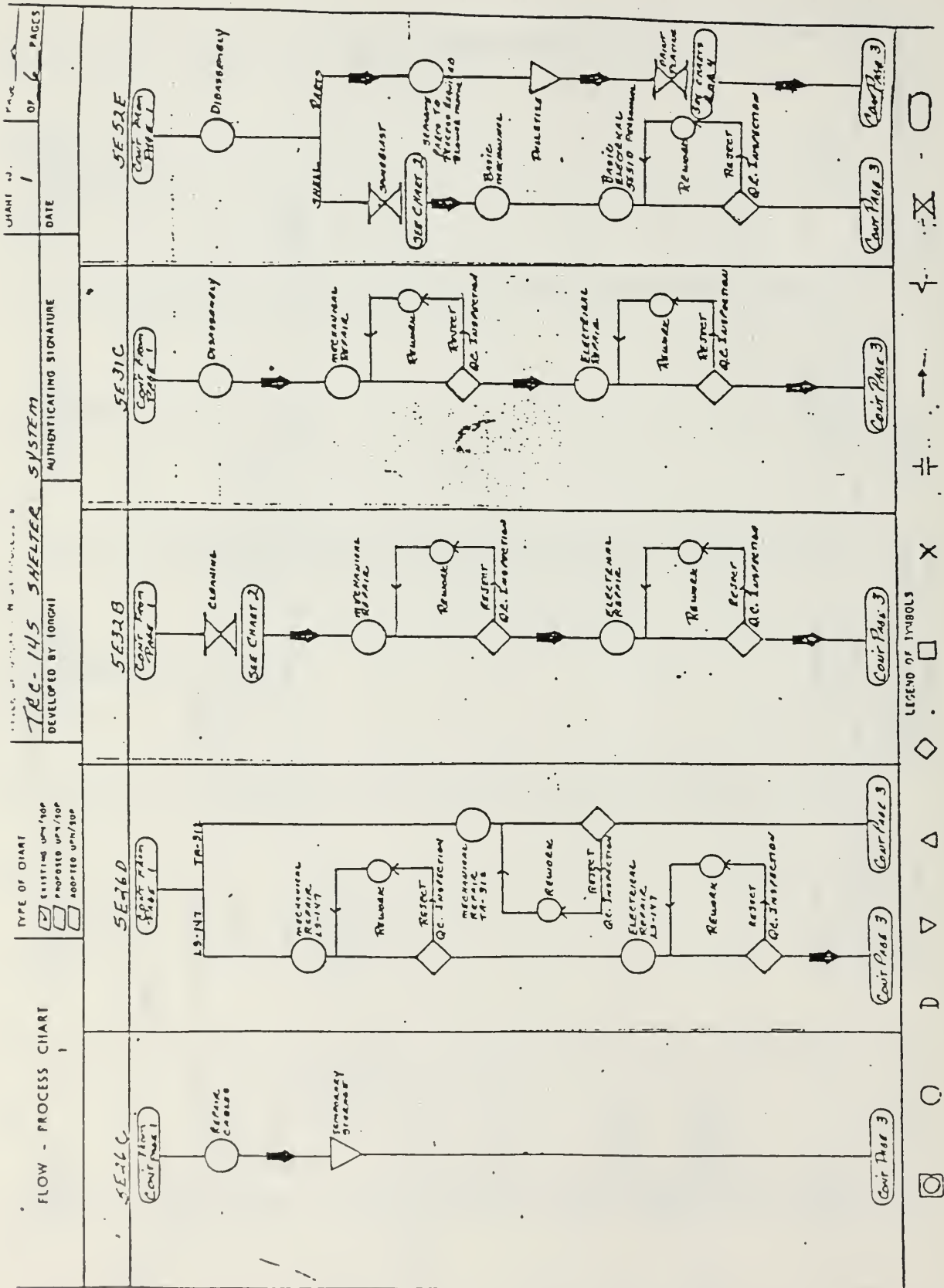


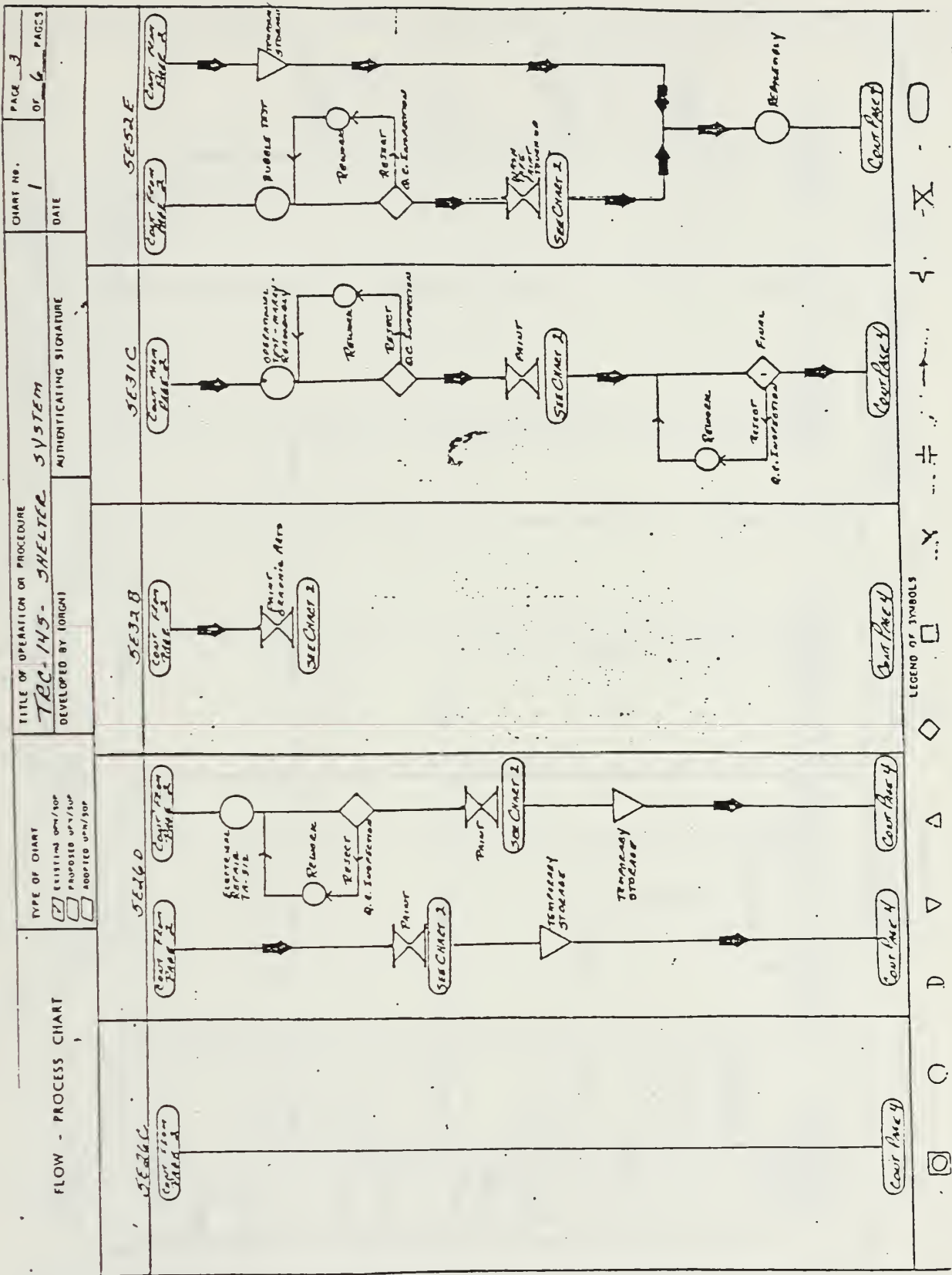
Source: Maintenance Directorate,
Sacramento Army Depot

FLOW PROCESS CHART

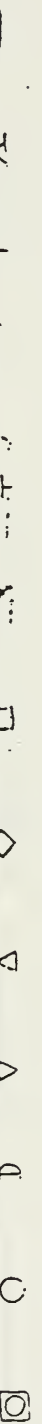
Source: Maintenance Directorate, Sacramento Army Depot







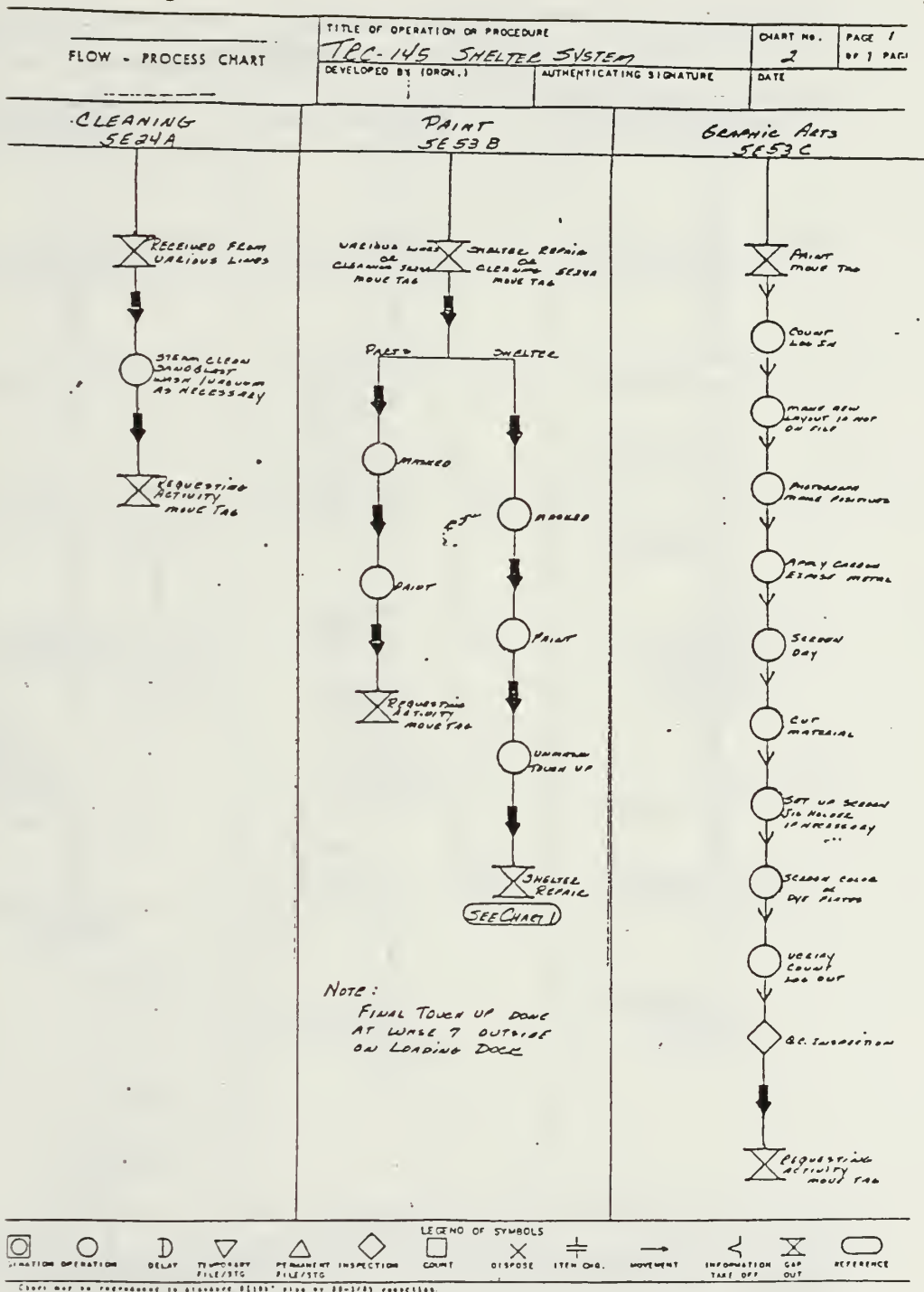
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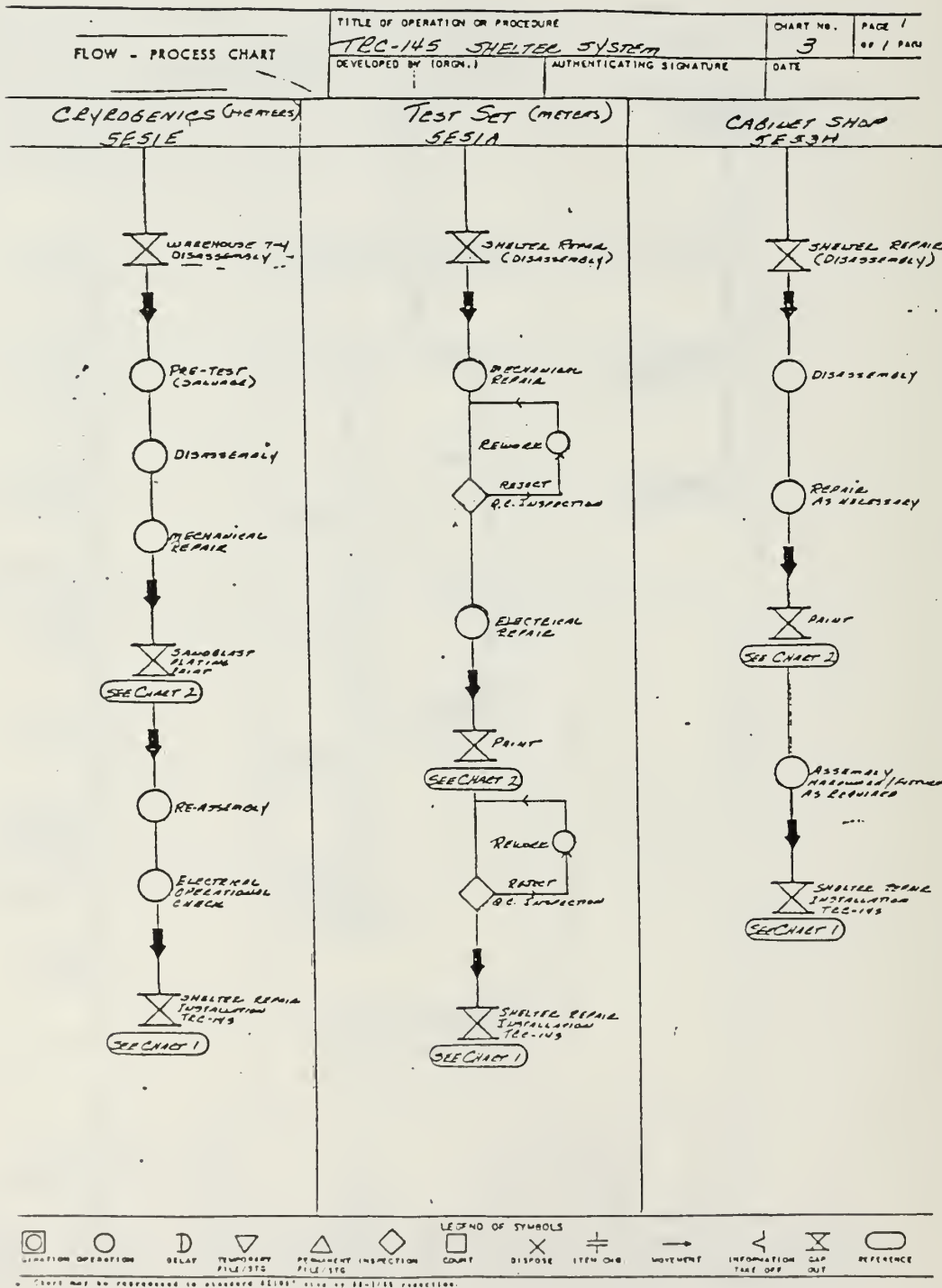


FLOW - PROCESS CHART 1	TYPE OF CHART <input checked="" type="checkbox"/> ASSISTING UNIT/SUP <input type="checkbox"/> EXISTING UNIT/SUP <input type="checkbox"/> ADAPTED UNIT/SUP	TITLE OF OPERATION OR PROCEDURE TRC-145 SHEETER SYSTEM DEVELOPED BY TONGAI	AUTHENTICATING SIGNATURE	CHART NO. 1 DATE	PAGE 5 OF 6 PAGES
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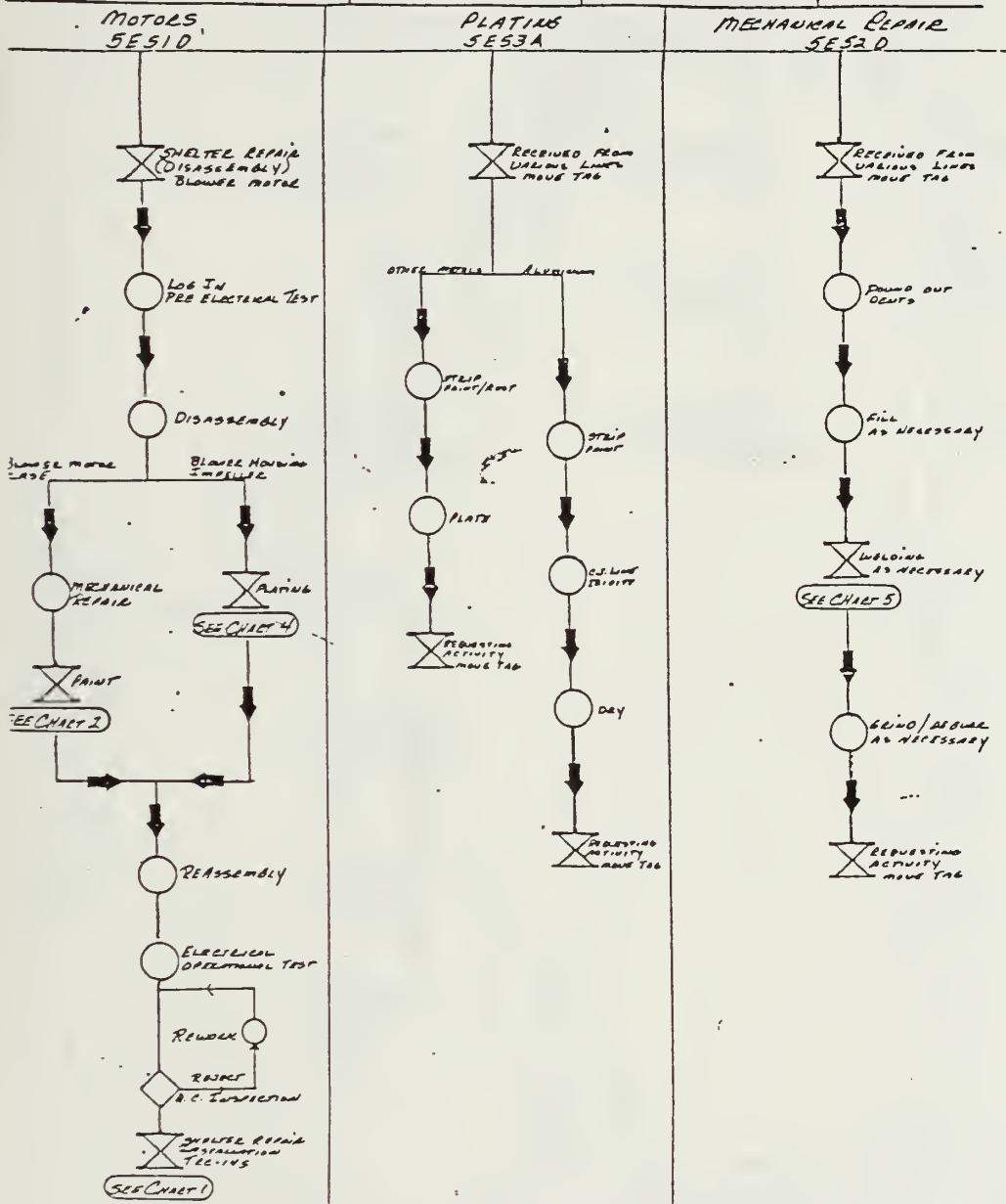
LEGEND OF SYMBOLS

☐ Start
☐ End
☐ Process
☐ Decision
☐ Release
☐ Driver
☐ Release



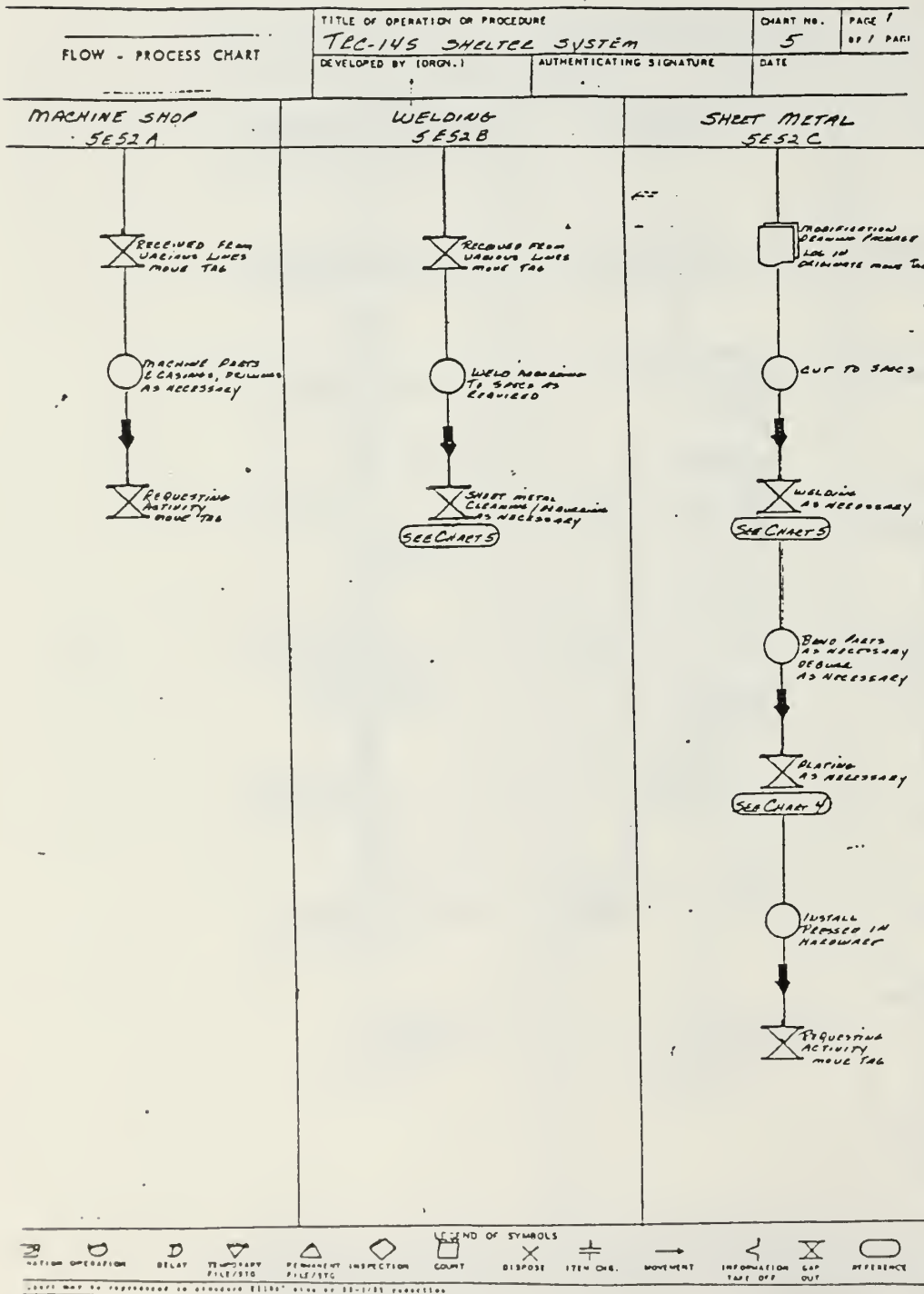


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	DEVELOPED BY (ORGN.)	AUTHENTICATING SIGNATURE	DATE	



START	END	DELAY	TEMPORARY FILE/STG	ATTACHMENT	INSPECTION FILE/STG	COUNT	BYPASS	ITEM CHG.	MOVEMENT	INFORMATION TAKE OFF	SET OUT	REFERENCE

CHART NOT TO BE PREPARED TO STANDARD ILLUSTRATION BY 15-1/35 REDUCTION



APPENDIX C

CONTENTS OF OASD REPORT RCS DD-M(A) 1397

Table Number	Description
1	Total Depot Maintenance Cost
2	Cost by Program Element and Commodity
3	Cost by Facility Type and Commodity
3A	Cost by Facility Type and Commodity- Depot Maintenance Work Performance Categories
3B	Cost by Facility Type and Commodity- Maintenance Support Work Performance Categories
4	Selected Facility Performance Statistics
5	Cost by Facility and Commodity
6	Cost Breakdown by Organic Depot Maintenance Activities
7	Organic Non-Depot Maintenance Activities
8	Cost Breakdown by Contract Activities
9	Cost Breakdown by Interservice Activities
10	Total Cost by Weapon System and Depot Maintenance Work Performance Categories
11	Maintenance Support Work Performance Categories
12	Items Maintained in Excess of 100% of Standard Inventory Price by Facility (Total Excess Greater than \$10,000)
13	Total Cost by Weapon System and Work Breakdown Structure (Depot Maintenance Work Performance Categories)
14	Items Repaired at More than One Facility (Production Qty. x Total Cost Greater than or Equal to \$150,000)

APPENDIX D

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-81	4-82	4-82	4-82
ITEM I.D.	5820004442328			
NOMENCLATURE	AM-2060 AUDIO AMP			
STD INVENTORY PRICE	98	87	87	87
WORK TYPE	OVERHAUL			
CUSTOMER	ARMY			
FACILITY	SACRAMENTO	SACRAMENTO	TOBY.	TOBY.
DIR CIV LABOR (PROD)	14158	3077	806	8531
DIR CIV LABOR (OTHER)	35	65	0	91
DIR MATL (FUNDED)	1228	10	0	749
DIR MATL (UNFUNDED)	0	0	0	0
OPERATIONS OVHD (FUNDED)	11491	2108	494	6177
OPERATIONS OVHD (UNFUNDED)	5347	841	18	202
GEN & ADMIN (FUNDED)	2431	570	88	987
GEN & ADMIN (UNFUNDED)	<u>1291</u>	<u>150</u>	<u>19</u>	<u>203</u>
TOTAL COST	35981	6821	1425	16940
QTY COMP	200	39	10	128
TOTAL DIR HRS	1112	230	70	773
DIR HRS PER UNIT	5.56	5.89	7	6.09
UNIT REPAIR COST	179.9	174.9	142.5	132.34

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-82			
ITEM I.D.	5820001848376			
NOMENCLATURE	MODULE F/AN/URC-80			
STD INVENTORY PRICE	672			
WORK TYPE	OVERHAUL			
CUSTOMER	ARMY	NAVY	ARMY	NAVY
FACILITY	SACRAMENTO	TOBY.	TOBY.	TOBY.
DIR CIV LABOR (PROD)	609	2431	911	2142
DIR CIV LABOR (OTHER)	13	39	42	75
DIR MATL (FUNDED)	130	0	0	0
DIR MATL (UNFUNDED)	0	0	0	0
OPERATIONS OVHD (FUNDED)	442	1301	577	1457
OPERATIONS OVHD (UNFUNDED)	127	127	21	50
GEN & ADMIN (FUNDED)	93	346	107	237
GEN & ADMIN (UNFUNDED)	<u>24</u>	<u>70</u>	<u>22</u>	<u>51</u>
TOTAL COST	1438	4314	1680	4012
QTY COMP	10	21	10	19
TOTAL DIR HRS	45	232	83	194
DIR HRS PER UNIT	4.5	11.04	8.3	10.21
UNIT REPAIR COST	143.8	205	168	211

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR.-YR. CONTRACT COMP.	4-81	4-81	4-80	3-79
ITEM I.D.	5820001848376			
NOMENCLATURE	MODULE F/AN/URC-80			
STD INVENTORY PRICE	672	672	672	544
WORK TYPE	OVERHAUL			
CUSTOMER	NAVY	ARMY	NAVY	ARMY
FACILITY	TOBY.	TOBY.	TOBY.	TOBY.
DIR CIV LABOR (PROD)	6071	172	1359	504
DIR CIV LABOR (OTHER)	79	10	290	18
DIR MATL (FUNDED)	853	0	50	114
DIR MATL (UNFUNDED)	0	0	0	0
OPERATIONS OVHD (FUNDED)	3597	96	901	258
OPERATIONS OVHD (UNFUNDED)	384	9	94	25
GEN & ADMIN (FUNDED)	883	25	238	96
GEN & ADMIN (UNFUNDED)	<u>141</u>	<u>5</u>	<u>48</u>	<u>21</u>
TOTAL COST	12008	317	2980	1036
QTY COMP	62	1	21	5
TOTAL DIR HRS	573	17	170	60
DIR HRS PER UNIT	9.24	17	8.09	12
UNIT REPAIR COST	193.68	317	141.9	207.2

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-82	4-82	4-81	4-81
ITEM I.D.	5820005033960			
NOMENCLATURE	R-417A/TRC RCVR			
STD INVENTORY PRICE	998			
WORK TYPE	OVERHAUL			
CUSTOMER	AIR FORCE	ARMY	AIR FORCE	ARMY
FACILITY	SACRAMENTO	TOBY.	SACRAMENTO	TOBY.
DIR CIV LABOR (PROD)	9060	4369	39136	522
DIR CIV LABOR (OTHER)	40	84	116	78
DIR MATL (FUNDED)	421	64	2935	315
DIR MATL (UNFUNDED)	0	0	0	0
OPERATIONS OVHD (FUNDED)	6701	1933	32021	329
OPERATIONS OVHD (UNFUNDED)	2458	77	14611	18
GEN & ADMIN (FUNDED)	1660	534	6764	83
GEN & ADMIN (UNFUNDED)	<u>286</u>	<u>109</u>	<u>3493</u>	<u>10</u>
TOTAL COST	20626	7170	99076	1355
QTY COMP	12	7	40	1
TOTAL DIR HRS	656	360	3011	52
DIR HRS PER UNIT	54.66	51.42	75.27	52
UNIT REPAIR COST	1718.13	1024	2476.9	1355

Source: Information provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP. 4-82

ITEM I.D. 5820002237548

NOMENCLATURE AN/GRC-106A RDO SET

STD INVENTORY PRICE 5829

WORK TYPE REPAIR

CUSTOMER ARMY

FACILITY	SACRAMENTO	TOBYHANNA
DIR CIV LABOR (PROD)	14949	70134
DIR CIV LABOR (OTHER)	43	476
DIR MATL (FUNDED)	3840	32267
DIR MATL (UNFUNDED)	525	700
OPERATIONS OVHD (FUNDED)	11574	41059
OPERATIONS OVHD (UNFUNDED)	4647	2627
GEN & ADMIN (FUNDED)	2603	9781
GEN & ADMIN (UNFUNDED)	<u>988</u>	<u>1678</u>
TOTAL COST	39169	158722
QTY COMP	50	347
TOTAL DIR HRS	1140	6633
DIR HRS PER UNIT	22.8	19.115
UNIT REPAIR COST	783.38	457.41

Source: Information Provided by The Office of the Assistant Secretary
of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-80	3-79	3-79
ITEM I.D.	5805009451075		
NOMENCLATURE	MULTIPL 1A11/TD353		
STD INVENTORY PRICE	163		
WORK TYPE	OVERHAUL		
CUSTOMER	ARMY		

FACILITY	TOBYHANNA	TOBYHANNA	TOBYHANNA
DIR CIV LABOR (PROD)	761	1670	1424
DIR CIV LABOR (OTHER)	54	28	84
DIR MATL (FUNDED)	1684	0	258
DIR MATL (UNFUNDED)	0	0	0
OPERATIONS OVHD (FUNDED)	463	913	907
OPERATIONS OVHD (UNFUNDED)	30	91	74
GEN & ADMIN (FUNDED)	111	312	238
GEN & ADMIN (UNFUNDED)	<u>19</u>	<u>57</u>	<u>40</u>
TOTAL COST	3122	3071	3025
QTY COMP	65	40	40
TOTAL DIR HRS	77	190	162
DIR HRS PER UNIT	1.86	4.75	4.05
UNIT REPAIR COST	48.03	76.78	75.62

Source: Information Provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP. 4-82

ITEM I.D. 5805009451075

NOMENCLATURE MULTIPL 1A11/TD353

STD INVENTORY PRICE 163

WORK TYPE OVERHAUL

CUSTOMER ARMY

FACILITY	SACRAMENTO	TOBYHANNA
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DIR CIV LABOR (PROD)	1256	1335
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DIR CIV LABOR (OTHER)	27	98
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DIR MATL (FUNDED)	28	992
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DIR MATL (UNFUNDED)	0	0
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OPERATIONS OVHD (FUNDED)	876	904
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OPERATIONS OVHD (UNFUNDED)	318	30
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GEN & ADMIN (FUNDED)	216	162
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GEN & ADMIN (UNFUNDED)	<u>57</u>	<u>31</u>
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TOTAL COST	2778	3552
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QTY COMP	33	36
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TOTAL DIR HRS	94	120
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DIR HRS PER UNIT	2.85	3.33
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UNIT REPAIR COST	84.18	98.66
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Source: Information Provided by The Office of the Assistant Secretary
of Defense (Manpower, Installation, and Logistics)

SACRAMENTO AND TOBYHANNA OVERHAUL/REPAIR
COST COMPARISON

QTR-YR. CONTRACT COMP.	4-82
ITEM I.D.	6625010606804
NOMENCLATURE	USM-451 RADIO
STD INVENTORY PRICE	500
WORK TYPE	REPAIR
CUSTOMER	ARMY

FACILITY	SACRAMENTO	TOBYHANNA
DIR CIV LABOR (PROD)	2058	11085
DIR CIV LABOR (OTHER)	25	129
DIR MATL (FUNDED)	0	0
DIR MATL (UNFUNDED)	0	0
OPERATIONS OVHD (FUNDED)	1497	6088
OPERATIONS OVHD (UNFUNDED)	166	191
GEN & ADMIN (FUNDED)	162	1107
GEN & ADMIN (UNFUNDED)	<u>39</u>	<u>220</u>
 TOTAL COST	 3947	 18820
QTY COMP	56	300
TOTAL DIR HRS	153	876
DIR HRS PER UNIT	2.7321	2.92
UNIT REPAIR COST	70.482	62.733

Source: Information Provided by The Office of the Assistant Secretary of Defense (Manpower, Installation, and Logistics)

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